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ENGINEERING AND MINING JOURNAL

A Weekly Journal of the Mining and Mineral Industries

Calculation of Anode-Furnace Charges in a Copper Refinery
By C. M. Brister, Jr.

Mineral Resources and Mining Possibilities of Finland
By J. J. Sederholm

The Burden of Mine Taxation
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By A. G. Wolf

Primitive Gold Sluicing at Sotajoki, Tributary of Ivalajoki, in Finnish Lapland

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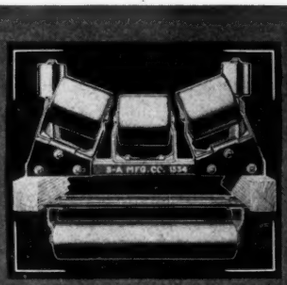

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Engineering and Mining Journal

A Weekly Journal of the Mining and Mineral Industries
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Licensing the Mining Industry

WE ARE BEGINNING TO WONDER who invented the word "engineer" and what should be done to him if he could be located. The question has been brought up by the discussion concerning engineer licenses, so widely pushed in many states. It appears that mining engineers are overwhelmingly opposed to engineer licenses, if we may judge from the referendum of the Mining and Metallurgical Society of America, the instructions of the Board of Directors of the American Institute of Mining and Metallurgical Engineers to their representatives on American Engineering Council in Washington, and the enthusiastic meeting on Jan. 11, of the New York Section of the Institute, which repudiated to a man the whole principle of licensing engineers. To a man—with perhaps one exception—a gentleman who is a member of the Institute, and yet somehow differentiated himself sharply from the mining engineer type with which we are familiar; a man who proclaimed that he had put through the New York bill, and framed the definition of engineer which prevailed as the criterion in enforcing the bill. There was a consensus of opinion that he should as an engineer be classed not primarily as a mining engineer but as a political engineer, despite his experience in quarrying; and there was a further tendency to the belief that political engineers should be licensed before they should be allowed to submit bills or to embark upon lobbying enterprises.

The New York definition of engineer in question provoked Homeric laughter among the Institute members. It recited in effect that an engineer was anyone who did or claimed to do anything that an engineer does in conducting engineering work; which, being shortened, said that an engineer was an engineer. Subsequent to the meeting, we inquisitively consulted the Standard Dictionary. It does better than the New York State definition. According to it, there are two kinds of engineers:

"1. One versed in or practicing any branch of engineering.

"2. One who runs or manages an engine: engine driver, engine runner, or engine man."

Clearly, what we are seeking to define is the former kind of engineer; so, consulting the word *engineering*, we find:

"Engineering: The science or art of making, building, or using engines and machines, or of designing and constructing public works or the like, requiring special knowledge of materials, machinery, and the laws of mechanics."

There is an evident certain limitation of this definition to mechanics, which makes it clear that a mechanical or a civil engineer, or an architect, or a yacht designer, is an engineer, since their work involves special knowledge of "materials, machinery, and the laws of mechanics"; but this definition does not so evidently include the land or mine surveyor, the assayer, the agriculturist, the geologist, the chemist, the mine manager or the metallurgist, to cite only a few examples.

The Standard Dictionary enumerates the following branches of engineering: Chemical, civil, dynamic, electrical, hydraulic, marine, mechanical, military, mining, agricultural, sanitary, municipal, steam, structural, topographical.

To anyone looking over this list it is evident that it is far from complete, and that current terminology has run ahead of this group, for we hear of investment engineering, metallurgical engineering, geological engineering, and even human engineering; and even the "editorial engineer" has been proposed as a member of the engineer group. Certainly, also, agricultural engineering, for example, might admit of specializing, as forestry engineering, horticultural or fruit engineering, dairy engineering, or sheep engineering. In fact, it must be evident that the word *engineer* as used does not indicate a certain calling or profession, but a certain very broad group classification. We think we can submit a more accurate and inclusive definition than does the dictionary—somewhat as follows:

"Engineering: The application of abstract natural science to human economic or industrial uses."

Then we should have, as the definition of engineer:

1. One who practices engineering.
2. One who runs an engine.

From this analysis, and since science and knowledge are respectively the Latin and the Anglo-Saxon words for the same thing, anyone versed in the natural sciences and turning them to utilitarian purposes would be an engineer. Our definition, it will be noted, eliminates the sciences which do not pertain to natural history, and, therefore, rules out as improperly named investment engineering, human engineering—yes, and political engineering. But even with this elimination, and with the broad range currently ascribed to engineering—there yet remains the fact that the definition of engineers includes a broad group, that it is as broad as the definition of capitalists or of workers, and with as shadowy boundaries.

It is impossible to make satisfactory specific laws or blanket rules to cover all the varied and practically unrelated callings grouped under the head of "engineer," or "capitalist," or "manual worker." We must get down to greater specificness, and consider, for example, in the first group, the land surveyor; in the second, the railroad owner; in the third, the coal miner. We have realized this for the last two groups; we must realize it for the first. What in common, for example, has a boiler expert in Seattle with a zinc metallurgist in New Jersey? And how can you make laws or frame examinations, or determine whether or not licenses should be required, in such a way that one blanket will cover all?

The term engineer, in our opinion, has done a lot of damage to us who are in the mining industry. If

politics makes strange bed fellows, it is equally true that the pursuit of the word engineer has brought those who have nothing in common under the same covers. We shall mention but not further comment on at present: the Engineering Societies Library, the American Engineering Council, the proposed Department of Public Works. We mining men have jumped the hurdles on all of these: now we have to hurdle the logical *sequitur* of Engineer Licenses.

Well, the Engineer License requirement tucks under its covers no less strange an assortment than it is proposed to warm under the Department of Public Works. We all agree that a deputy mineral surveyor should be granted a permit before he can qualify; but we all agree, also, that the same examination, at least, will not cover the case of the consulting metallurgist or the itinerant geologist, or the shrewd executive who wants to manage a mine; and we doubt the advisability of a general licensing regulation. Such a legislation would have thrown Edison and Ford, both unschooled men, into jail; and their only way of getting forward would have been the practice of bootlegging engineering. Indeed, the New York licensing law makes bootlegging or illegal engineering mandatory, since it requires that no one may lawfully practice engineering until he shall have had six years' experience, of which one year must have been in a position of responsibility. The penalty is fine and imprisonment; and it will be a question for the courts to solve whether engineering practiced in jail will be eventually counted toward the legal requirements.

We fear that the remedy for all our troubles, from the Engineering Societies Library through the Department of Public Works, to Engineer Licenses, will be a more restricted claim on our part to the designation of the nice word engineer, to which we all have been fondly laying claim. We may have to acknowledge ourselves for what we are: a metallurgist, not an engineer; a mine manager, not an engineer; an appraiser of mines, not an engineer; a bond salesman, and not an investment engineer; a common nuisance, and not a political engineer; a geologist, and not a mine development engineer; a cyanide-process specialist, and not a mining engineer; a quarryman, and not a mining engineer. If you will do that, by the laws of many states at least, you will not have to be licensed and restricted in your vocation, and be confused with the boiler expert or the transitman, or the central-station man.

Evidently, the time is almost ripe to unscramble the egg, or disintegrate the hash by flotation; and for our group to recognize that it is not engineering we serve, but the mining industry. Many societies will go to pieces if the word engineer becomes unpopular—so much hangs upon a word. And it looks to us as if it were in a fair way to become less and less popular.

The Lecture System

WE SELECT the following extract from the report of the Committee on Technical Education of the Mining and Metallurgical Society of America:

"American colleges and universities appear to be committed to the lecture system, and teachers in many branches are accustomed to ridicule what they choose to call the 'district-school' method of instruction by means of textbook and recitations when any criticism of the lecture system is advanced. Yet, as we all know, but few teachers are of ever will be really good lecturers. More important is the necessary admission that lectures, as compared with a good textbook, form a most unreliable and ineffectual means of placing any desired information as record in the student's hands. The student is continually distraught between his effort to understand and absorb what the lecturer says and his effort to take it down clearly in his notes. Few students are able to do both things well. The divergence between what the lecturer intends to say and what the average student's notes really contain is appalling, and it can hardly be doubted that many teachers unconsciously take advantage of this loophole of responsibility by giving lectures that for substance, accuracy, and presentation they would be ashamed to see in print."

The reason for the lecture system is that it is the easiest way and a natural one. The earnest, capable student who does his part and follows up his subject with collateral reading will get a good deal out of a subject, even though the lecturer be indifferent. Not every student is canny enough to keep up a systematic notebook, and only a relatively few students are imbued with that pertinacity and vision to realize their immediate opportunities. Most of them are human, and have lazy spells interspersed between periods of energetic effort. It requires a fairly capable man to keep "steam power" up on all the diversified subjects given in a term, and it must be admitted that a cafeteria type of education has sprung up where classes are large and instructors few.

On the other hand, the "district-school" method of instruction by means of textbooks and recitation has only limited application, partly because suitable textbooks are seldom available outside of fundamental courses and partly because experienced instructors make use of methods of individual contact that are an improvement over "district-school recitation." The availability of libraries which are usually segregated for different groups of students has made the absence of good textbooks on some subjects less noticeable. However, a reference book that is comprehensive is an excellent thing to have in the possession of the student.

Experienced instructors generally are aware of the weaknesses of the lecture system and resort to various expedients to overcome them. Some provide systematic notes in mimeographed form. Others advise the weaker students to secure reference books that cover the subject. A series of problems is given where suitable. Still others resort to the laborious checking of the student's notes at intervals. To maintain individual contact, written and oral quizzes are given at regular intervals, sometimes at the beginning of each lecture period. Another method is to require reports and notes upon collateral reading, and still another is to give systematic notes and devote the classroom time to thorough discussion of the subject by the members of the class, led by the instructor. We know of one professor who presents subjects with references and requires his students to prepare a certain number of lectures, each presenting a simple lecture for discussion. With advanced students the lecture is dispensed with and a round-table discussion of the subject undertaken.

An experienced instructor is well aware of the devious methods undertaken by some students to get by without "work," and his ingenuity is taxed sometimes to "beat them to it." The trite expression that the educational method should be one "that makes a student think" involves a principle that is well understood and made use of by skillful instructors. With a class of not to

exceed fifteen students, such instructors will do the trick. With larger classes, it becomes more difficult, and with audiences altogether uncertain.

Subjects differ in their degree of difficulty, and methods of presentation have to be changed accordingly. Experienced instructors vary their methods with both individual students and with classes as a whole. We believe that there are many instructors and professors who are doing mighty good work and not getting any publicity from it. We believe that many succeed in "getting everyone in the game" and give their students a good chance to do some of the talking and writing themselves. This is the corrective for "passive receptivity" and the ingrown student type.

Enter Boston & Montana Amid Fanfare of Brokers' Trumpets

WE SHALL LOOK with much interest on the outcome of the Boston & Montana project. As those of our readers who are favored with stockbrokers' circulars—and who is not?—must by this time know, this company has now reached the producing stage, and by the time this appears will be treating possibly 500 tons a day in the new mill. The property is at Elkhorn, in Beaverhead County, Mont., and was first opened in 1865. It is in no sense therefore a young untamed wildcat. Many well-mineralized veins were in evidence, but operations at the property were much hampered by poor transportation facilities. This was remedied two years ago by the construction of a narrow-gage railway from the mine, on the Wise River, to the Union Pacific system at Divide. Development in the last two or three years has been active, and it was stated more than two years ago that $2,500,000 had been spent in exploration.

Some doubt has been expressed by competent engineers as to whether sufficient ore has been developed to warrant the erection of a mill. Others affirm that plenty of ore is available. At any rate, the project cannot be classed with some of the Southern gold mines, about which it is said that "the company closes down as soon as the mill starts," for the Boston & Montana mill has now been operating for two or three months.

We really might be quite enthusiastic about this company except for one thing, and that is the flamboyant stock-jobbing campaign that has been conducted. Every broker's circular is filled with Boston & Montana. The writers overlook nothing, one day confining themselves to cold hard facts, whereas the next day they reach up into the heights of the superlative and attempt to pull down the ultimate in language. The name is fondly coupled with Anaconda, United Verde, and Calumet & Hecla. Recently the stock was compared with Hollinger as an investment—needless to say to the disadvantage of the Ontario bonanza. Moving pictures made at the property are being shown wherever there is a likelihood of collecting a large crowd of men, each with a few idle dollars in his pocket. No stone is being left unturned, except possibly some in the mine, to market the stock.

The Superficial Enrichment of Ores

ONE OF THE NOTABLE FEATURES of the recent meeting of the Society of Economic Geologists at Amherst was the general agreement to the effect that much if not most of the rich silver sulphide (sulpharsenide or sulphantimonide) ores are of primary origin—that is, deposited by ascending waters, which are generally believed to be of magmatic or igneous origin. For a long time it has been the fashion to believe that these rich silver ores were necessarily of secondary origin, due to concentration from a leaner form, through the agency of descending surface waters —were, in short, due to "secondary enrichment," quite as so many copper ores, especially rich sulphides like chalcocite, are actually so formed.

The pendulum of enthusiasm over secondary enrichment is swinging back to the logical and normal. Most marked in the case of copper, this process is least marked, perhaps, in ores like those of gold and tungsten: indeed, it is likely that it is misleading even to use the term in connection with ores of such metals, even though superficial enrichment may be striking, as especially in the case of outcropping gold veins. In this case, however, the enrichment is due largely to mechanical rather than chemical causes—the residual gold, heavier than the eroded and in part dissolved superficial quartz, sinks into crevices and is carried in fine suspension a considerable distance below the outcrop, though characteristically, as is natural from the mode of origin, richest on the outcrop itself.

Finally, even in the case of copper, it has been found that the rich copper sulphides, which were once, in the glow of young enthusiasm over the perception of the importance of "secondary sulphide enrichment" of lean copper pyrites, believed to be necessarily secondary—such rich sulphides as chalcocite and bornite—are in many cases of deep-seated, primary, and immediately (it is assumed) magmatic origin. Therefore, the same rich copper sulphides may form either as primary and deep-seated or secondary and shallow-formed ores; and it is now recognized that the same is true of the rich silver sulphides, with the difference that in the case of silver, the rich ores of primary or deep-seated origin are perhaps quantitatively more important, which, surveying the whole field, is not the case with copper ores.

WHAT OTHERS THINK

The Distillation of Oil Shale

A study of George A. Thiel's article on the subject "Gas an Important Factor in Oil Accumulation," in *Engineering and Mining Journal* of April 10, 1920, suggests the possibilities of gaining much additional information by carrying the tests further.

A large amount of data on the behavior of oil and air and oil and gases can be obtained if the oil investigator will trespass on the field of the metallurgist as relating to the investigations in connection with the use of oils in the flotation process. Thus, two radically different fields of investigation may be of mutual benefit.

It is assumed that in the process of natural distillation of petroleum, or its natural production, natural gas is at the same time evolved. The process may or may not be under pressure. It may be under artesian water pressure or of natural pressure due to the evolution of gas and oil vapors. However, I doubt if pressure, as suggested by Mr. Thiel, is an essential factor. Sulphur is shown by analysis in most oils. Hydrochloric acid may be, and probably is, present or evolved in the presence of salt water in the chemical processes under way. The distillation of oil and gas, contemporaneously, in

close confinement, even though not under pressure, would produce a mobile fluid which would readily diffuse through the least-resistent medium, and, under natural physical laws, follow the line of least resistance.

An interesting extension of the experiments made by Mr. Thiel would be to carry them out in connection with the distillation of an oil shale. The test should be made under such pressure as developed in the process of distillation and also under conditions of atmospheric pressure, noting the comparative behavior.

It would be interesting to compare the action of the condensed oil when passed to the tube used after allowing the gas formed to separate and pass off before conducting to the testing apparatus; also to note the behavior, in comparison with this test, when permitting the products, as formed, direct access to the test apparatus.

It would be necessary to connect the two ends of the tube, say as the diameter, with a semicircular pipe with the intake from the distillation apparatus connected midway of the circumference, thus allowing the flow of the products of distillation to both ends of the tube under the same conditions. The pipe might be arranged for condensing, as well, the "crest" of the tube tapped and connected, through a water seal, with atmospheric pressure.

This test would disclose the effect of the natural-gas evolution on the segregation of the oil and behavior of the oil without the gas, in its segregation, as illustrated in the original experiment with artificially evolved gas of a different nature.

Mr. Thiel, in referring to the experiment with the tube inverted (synclinal), remarks: "The first evidences of accumulation were seen on the *upper* surface of the tube throughout its entire length. At the end of thirty-six hours, however, the oil had moved in both directions from the trough of the syncline, forming a concentration in the upper part of the limbs, immediately below the contact between the dolomite and the quartzite. Such behavior indicates that the migration of the oil is not dependent *upon the direct movement of the gas*, as the oil moved toward the source of gas supply." But, he further says: "'This *did not occur* until after a uniform pressure had been developed throughout the oil-sand and water mixture." He mentions no segregation of gas from oil during this stage; hence, we may assume that they were intimately associated, the gas, possibly, as in the flotation process, with its film of oil surrounding, and, together, a mobile fluid now moving under physical laws in a quiescent "atmosphere" ("a uniform pressure had been developed"), through a thus established counter-current of the salt water. This should occur whether the elements are or are not under pressure.

The experiment in connection with distillation from a retort would afford interesting results, as the gas and oil, together, introduced at the upper ends of the syncline, or through the opening at the peak of the arch (used for connecting with the atmosphere), would be traveling together. The dolomite plugs would not be used in connection with the retort experiment. It will be necessary to connect the tube with a vessel of salt water, by siphon or otherwise, to allow for displacement, in the tube, by the oil and gas introduced.

There is a close analogy between the oil-gas mixture, traveling through the minute interspaces of the "sands" —which prevent segregation during migration—and the action of the bubble of air, however minute, inclosed by its film of oil, thus much more buoyant than the oil when alone suspended in fresh or salt water as observed in flotation practice.

L. S. ROPES.

Helena, Mont.

A New Year's Greeting From Montana

I consider *Engineering and Mining Journal* as part of my equipment for the conducting of my operations. It is *standard* and is accepted so by many that are not subscribers. They will spend $4 for a magazine that purports to cover the same field, but they are very grateful for the opportunity to peruse the *Journal*.

Every so often I have a "round-up" of my journals. Here is the way I look at it: You go for a ride in an auto of the $2,000 or $3,000 class—you enjoy it and say it is fine; then get into a car of the $6,000 to $12,000 class, and the superiority is unmistakable. The analogy is complete. Read any of the several periodicals devoted to the mining industry and then read *Engineering and Mining Journal*. The same superiority is manifest. Superior class of contributors, "the leaders in the business"; superior presentation of the subjects by the contributors, superior class of advertisers and advertisements; and, above all, *reliability*.

I wish the *Journal* its most prosperous year.

Kendall, Mont. FRANK B. BRYANT.

The White Iron & Coal Co.

In *Engineering and Mining Journal* of Dec. 24, on page 1035, under the caption "Alabama," George Huntington Clark credits the Great Southern Steel Co. with having absorbed the White Iron & Coal Co., This is an error.

While efforts to that end have been made, they were unsuccessful. The White Iron properties have an especial value in that all the raw materials necessary to the prodution of pig iron are contained in its holdings, thus eliminating the burdensome freight rates of the present day. Plans are being perfected whereby the Robert W. Hunt & Co., as operating managers, will open both coal and iron mines in the near future and it is safe to say that any proposed merger with any company at the present time will be firmly declined by this company.

Chicago, Ill. H. F. PENNINGTON.
Vice-Pres., White Iron & Coal Co.

Romance vs. Reality

Permit me to express my appreciation of your comments upon the statements and doings of L. V. J. Kimball, "Romantic" Geologist, appearing in *Engineering and Mining Journal* of Dec. 24, 1921. It certainly seems remarkable to real geologists, who have with arduous and painstaking care followed along the lines of legitimate and accepted research, that a wild-eyed faker, such as the one under discussion, should so easily blind normally sensible people to conditions as they are, and gather their money for the furtherance of worse than wildcat schemes, while the really valuable opinion of the legitimate but not "romantic" geologist would attract no attention.

I hope that *Engineering and Mining Journal* will continue its good work, though it is almost too much to hope that the efforts put forth will be sufficient to overcome the inherent asininity of the mass mind.

Salt Lake City, Utah. A. G. BURRITT.

Mineral Resources and Mining Possibilities Of Finland

Scientific Prospecting Under the Direction of the Finnish Government Is Adding to the Knowledge of the Country's Mineral Deposits and Potentialities—Iron, Copper, And Pyrite the Most Important Products Mined

BY J. J. SEDERHOLM*

Written for *Engineering and Mining Journal*

THE ECONOMIC CONDITIONS of Finland have attracted attention from the moment that the country, earlier an autonomous Grand Duchy under the sceptre of the Czar, became an independent republic, free to make new connections and eager to increase her income, so as to balance a steadily growing public expenditure. Besides the agriculture, lumber, and paper industries, the mining industry has been considered worthy of especial attention, though it has not yet attained the development which might well have been anticipated, because Finland has the same geological structure as her neighbor Sweden, which is so rich in various ores.

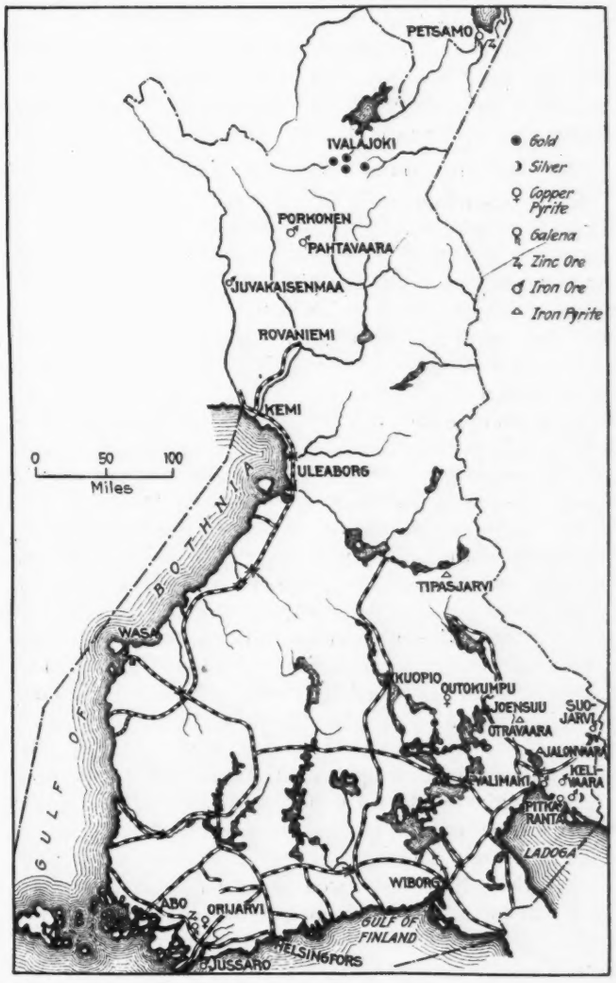
In Finland practically all rocks are of pre-Cambrian age, and some of them are geologically nearly related to the ore-bearing rocks of Sweden. For a long time, however, no orebodies of considerable importance were discovered in Finland, although prospecting has been done for several centuries, often by experienced Swedish miners. After the political separation of Finland from Sweden, in 1809, systematical efforts to discover new orebodies were continued. Most of the prospecting was by officials of the Finnish government. Since 1877, a geological survey has existed in Helsingfors, from 1885 as a separate bureau. In 1918 this survey was much enlarged. Only twenty years ago Finland was mentioned as having expended a greater amount of money than any other European country in proportion to her population on geological exploration. At present the yearly expenditures of the Geological Survey are considerable in proportion to the area of Finland, according to which Finland now ranks sixth in order among the European states.

GEOLOGICAL SURVEY ACTIVE

During the first decades of the existence of the Geological Survey, its activity was directed mainly to the scientific study of the geology of the country, but since the beginning of the twentieth century the investigation of mineral resources has assumed a more and more predominant place.

Most of the prospecting work in Finland is now being done by the Geological Survey, which has also tried to develop the method of such research, and especially has devoted much study to the methods of electrical prospecting. Some private companies are doing similar work, whereas prospecting by individual miners is done only in a small measure.

Prospecting is now conducted in Finland mainly by a detailed survey of those areas where further discoveries may be anticipated, attention being devoted especially to glacial boulders. If among them any consisting of ore are found, or a discovery of boulders of ore has been announced by a prospector or casual investigator, every effort is made to trace the boulders to their origin. For this purpose geological maps are consulted and all available data concerning the directions of the movement of the ice that has carried the boulders are used.



MAP OF ORE DEPOSITS OF FINLAND

ELECTRICAL PROSPECTING SUCCESSFULLY EMPLOYED

When it seems probable that a certain area contains ore, a magnetometric survey is often made, because experience has shown that the non-magnetic ores are often connected with pyrrhotite or magnetite, and a magnetometric map will often show the strikes of the hidden rock masses.

Frequently electrical mapping is done by methods

*Director of the Geological Survey of Finland.

which allow of exact determinations. Those methods, which are kept secret, differ in many important points from those which have been used elsewhere. No equipotential lines are determined, as in the well-known method of Schlumberger, but the differences in the underground conductivity are ascertained at regular distances. The result is a map similar to a magnetometric map. Where indications of the existence of orebodies have been revealed by these methods, the investigation is continued with the aid of diamond drilling and regular prospecting by mining. These endeavors to discover new ores have been in part successful, several orebodies, one of them very valuable, having been found, and there is hope of further discoveries, which may change Finland to a mining country. Experience denoting the most successful way of prospecting is thus different in Finland from what it has been in many other countries.

Scientific Methods Disclosing Mineral Deposits

In his important work on international mining laws Theo F. Van Wagenen summarizes the American opinion in the following words: "It is to be remembered that everywhere in the world the mining industry began either with discoveries resulting from the conscious and intelligent efforts of laboring men, or by accident. There are no records of mines found by scientists or professional men of any kind."

In Finland, on the contrary, all discoveries of new orebodies made during the last few decades have been made by professional men employing scientific methods, and it is regarded as proved that such research possesses successful possibilities where even the most intelligent prospector of the laboring classes would fail completely. Scientific prospecting is no more merely a theory; it may be confidently said to be a proved success.

Along the southern shore of Finland stretches a zone of rocks some of which certainly correspond geologically to the iron-bearing "leptitic" rocks of Middle Sweden. Also, in Finland those "leptites" contain intercalated layers of magnetite, but these orebodies are generally small and much mixed up with the Archæan granites, which in this region intimately penetrate all the older rocks. Some ore from these small orebodies was used, when labor was cheap, by the Finnish iron works, but most of them have had recourse to magnetite imported from Sweden. Finnish lake and bog ore may also be used. It occurs at the bottom of many lakes in abundant quantities, mainly where there are deposits of glacial sand from which the iron constituents have been leached out by water containing humic acids.

Iron Ores Located With Magnetic Compass

On the island Jussarö, west of Helsingfors, magnetite forms a large orebody two miles long, as has been indicated by magnetometric surveying, but the ore contains on the average only 25 to 29 per cent iron, but sometimes runs as high as 30 to 35 per cent. Some of the iron is in the form of a ferrous silicate. Moreover, the greatest part of the orebody lies under the surface of the sea, and the main shaft is situated on a small island. Despite these difficulties endeavors have been made, and are still continued, to use that ore with magnetic concentration. Over wide areas of the surrounding sea the compass is disturbed by the influence of these iron ores, a phenomenon that has caused many shipwrecks. These iron ores of southern Finland either occur with old basic eruptive rocks or with limestones intercalated with the "leptites."

A titaniferous iron ore of another type occurs at Välimäki, on the northeastern shore of Lake Ladoga, near the Russian boundary. The ore is a magnetite concentration in a gabbro, and the richest parts of it contain only 23 per cent of iron. The ore has been concentrated by magnetic separation, yielding a product containing only 0.01 per cent of sulphur, practically no phosphorus, and 4 to 5 per cent of titanic oxide.

During the years 1896 to 1907, about 100,000 tons of concentrate was recovered, together with some lump ore, products which were smelted in a blast furnace on the Russian side of the boundary.

Expectations of finding in Finnish Lapland iron ore of the same type as the famous orebodies in Sweden have repeatedly been disappointed. The ore-bearing rocks of Swedish Lapland have a north-south strike, along the boundary, and rocks of that type do not occur on the Finnish side. The iron ores of northern Finland are markedly different from the ores of Kiiruna and Gellivaara, in northern Sweden.

Magnetite Found in Northern Finland

The greatest bodies of iron ore of northern Finland occur in the Porkonen-Pahtavaara area in Kittilä, more than 100 miles from the nearest station of the Finnish railway system which ends at Rovaniemi, on the Arctic Circle. If a railway were built to the Arctic Ocean, it would pass at a distance of less than thirty miles from these orebodies. They have been known for nearly a century, and the greater part of them were magnetometrically surveyed by Dr. Mäkinen, of the Geological Survey of Finland, in 1920; some portions of them earlier than that year. The ore is magnetite, and forms intercalations in a quartzitic schist. It has much the same character as the Keewatin ore of Canada and the ore of South-Varanger, in northern Norway, near to the present boundary, of which it may possibly be a continuation.

Those parts of the ore of Kittilä which are to a large extent visible at the surface occupy an area of 27.1 *har*, or 66.8 acres. The magnetometer reveals an area of at least 36.5 *har*, or 90 acres. For comparison, it may be mentioned that the Kiiruna-Luossavaara area of Sweden measures 114 acres and that of Gellivaara 56 acres.

The dip of the schists in which the Finnish ores are intercalated is predominantly vertical, and the beds are much tilted and contorted. If the depth is assumed to be only 100 m., the total mass of the orebody is at least 150,000,000 to 200,000,000 tons. The ore is everywhere amenable to concentration, most of it containing about 40 per cent iron, 0.15 to 0.5 per cent phosphorus and 0.034 to 0.067 per cent sulphur. The magnetite is finely divided, which makes separation difficult. The ore field is largely owned by private persons, though a part of it is the property of the state.

One Deposit Known for a Long Time

At Kolari, near to the Swedish boundary, there is another iron orebody, Juvakaisenmaa, which has also been known for about three centuries, and which has been recently surveyed magnetometrically and in part also investigated by the aid of diamond drilling. The ore is intercalated with mica schists, and has been followed to a length of about one English mile. The best

part of the ore, which has an iron content of about 55 per cent, has a thickness of 6 to 10 ft., and the whole ore zone, which averages about 40 per cent of iron, has double this thickness. The ore does not contain more than 0.01 to 0.09 per cent phosphorus, but carries a rather considerable amount of sulphur, because pyrite is present. Good limestone and quartz occur in the neighborhood. This orebody is more than 100 miles distant from the nearest railway, but possibly one will be built to that continuation of the ore which has been found at the Swedish side.

In Suojärvi, in southeastern Finland, occur layers of hematite 4 to 5 ft. thick and several miles long, which are intercalated with the pre-Cambrian dolomites which belong to the Jatulian formation. A lump ore can be extracted with an average content of 50 per cent iron. This ore field, which is situated near to the terminus of a railway which is now being built, will probably eventually become of much importance. Concentrating ore certainly occurs in several places in the quartzitic areas of eastern and northern Finland.

There is a further possibility, if the pyritic ores of Finland are treated by the chlorination process, or by electrolytic methods, of using purple ore as a material for producing iron. Because of the short transport, imported Swedish iron ore will also be cheap. In the production cost of the pig iron imported from Sweden in 1918, the item for ore formed only about 10 per cent of the whole cost, and as charcoal and labor are cheaper in Finland, it would appear to be advantageous to produce steel from Swedish ore.

Electrical Smelting a Possibility

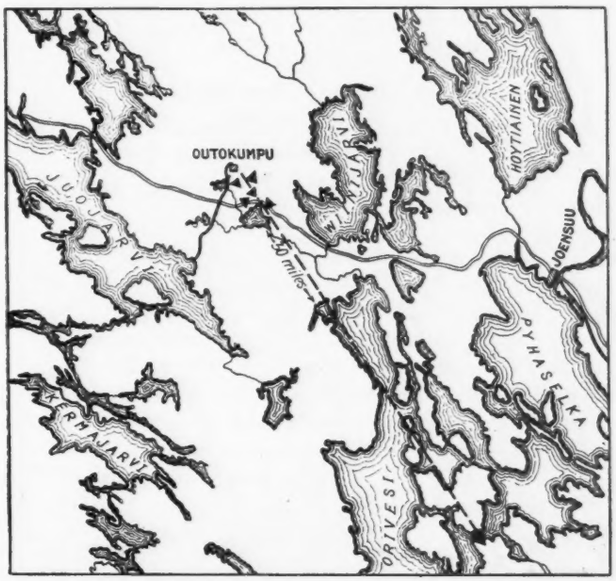
When it is further considered that Finland possesses an abundance of water power and is near to Russia, which may soon again be a good market for industrial products, the possibility of an iron industry on a larger scale does not seem remote. In fact, it is entirely probable that electrical smelting may soon be an important industry in Finland. At the Imatra rapids, which belong to the state, nearly 200,000 hp. are available and will probably be utilized in the near future, and despite the increased cost of construction, it is expected that electric power will be obtained at a price not higher than before the war.

In southern Finland a prospect of nickeliferous pyrrhotite has been found, but it seems to be of no importance. At another place, however, promising prospects of nickel ore exist, although nothing definite can be said about them at present.

Only a Few Important Deposits of Pyrite

Pyritic ores are rather common in Finland, although only a few are of importance. The pyritic copper ore field of Orijärvi, in southern Finland, is geologically analogous to the famous pyritic copper orebody of Falun, in Sweden. But although the last named is one of the largest orebodies of this type existing, having yielded 500,000 tons of copper, 15 tons of silver and 1.5 tons of gold, the Orijärvi field, which has been worked since 1757, has not produced more than 4,500 tons of copper. The average copper content of all the ore mined is only 0.6 per cent, and the ore is found with sphalerite. Also, some gold, connected with selenium, occurs in the orebody. Geologically, the ore is interesting, because it is, as has been shown by Dr. Eskola, connected with cordierite-anthophyllite rock, often rich in quartz. This rock has been formed by a metasomatic change of a fine-grained "leptitic" schist caused by the contact action of the oldest Archæan granite of the region. By metasomatesis much magnesia and iron have been added to the original rock. This cordierite-anthophyllite rock has been shown to occur in so many instances in connection with pyritic ores as to be regarded as an important indicator when prospecting for such ores in the Archæan of Fenno-Scandia.

The Pitkäranta ore field, on the northeastern shore of Lake Ladoga, is geologically extremely interesting, although the mining at that place has thus far achieved no great success. During a century, 6,600 tons of copper have been won, together with 488 tons of tin and 11 tons of silver. The magnetic iron ore of Pitkäranta, which forms the main part of the orebodies, has also been used. The quantity of probable ore seems to be at least 12,000,000 tons, but the iron ore is much mixed up with copper pyrites and sphalerite. It is probably a unique instance that the same mine is able to



TRACING A BOULDER OF ORE TO ITS ORIGIN, SHOWING WHERE THE FIRST BOULDER OF ORE FROM OUTOKUMPU WAS FOUND AND THE DIRECTION IN WHICH IT TRAVELED

produce copper, zinc, silver, lead, tin, and iron ore. All these different ores occur within narrow zones of crystalline limestone, which form the layers of the Ladogian system, next to its base of granitic gneisses, but the mineralization occurs only near the contacts of a late pre-Cambrian granite, from which gases and solutions have emanated, causing the formation of the ores. This typical example of the contact action of a granite has been well known through the detailed description of O. Trüstedt. At Kelivaara, about 1.5 miles north of Pitkäranta, a similar orebody consisting of magnetite has been discovered by Mr. Trüstedt.

Copper Deposit Located

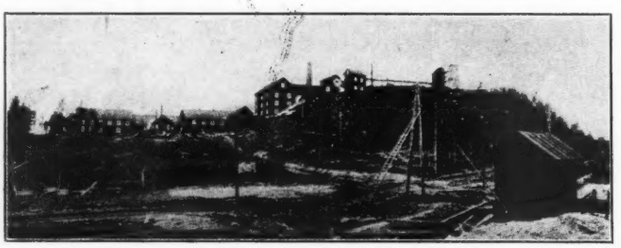
Of markedly different character is the copper ore of Outokumpu, in Kuusjärvi, which was discovered in 1909. A boulder of copper ore had been found at the digging of a channel, and the Geological Survey charged O. Trüstedt to trace it to its origin. The neighboring regions had been mapped, and quartzites similar to that which carried the ore were known to exist only in few places, which were visited. In one of them, thirty

miles distant from where the boulder was discovered, Mr. Trüstedt found an area overstrewn with boulders of similar ore. The outcrops of the ore were hidden, but with the aid of diamond drilling an orebody was detected which has a thickness of three to thirty feet and a length of nearly two miles. The ore shoot follows a fissured zone in the quartzite dipping 50 deg. south, and plunges to the west. It is divided by a great fault, but otherwise seems almost as regular as a coal seam. The copper content is 4 to 6 per cent, with 1.15 per cent zinc, 28 per cent sulphur and small amounts of silver and gold. At a depth of 600 ft. it has still a maximum thickness of 28 ft., and the ore in sight is estimated to be at least 8,000,000 tons, and the probable ore is 50 per cent or 100 per cent more.

The ore occurs with a serpentinized peridotite, but it is also cut by pegmatitic veins which have been brecciated and cemented by ore, and it is still an open question whether the basic rocks or the granite has carried the ore. In every occurrence a part of the ore has been dissolved and redeposited at the time of the intrusion of the granite.

Copper Production Not Large

Although this big ore deposit has good communications, lying near to Lake Saima, which is connected with the sea, and a railway having been built to the nearest harbor, the production of copper has thus far been inconsiderable. Half of the mine belongs to the state as its discoverer, and another half to a wealthy firm in Wiborg, owner of the ground where the ore was found. The ore has been treated by an electrical process invented by Mr. Hybinette, the nickel and copper metallurgist, who also leased the mine for a time. The copper works are now again run by the owners.

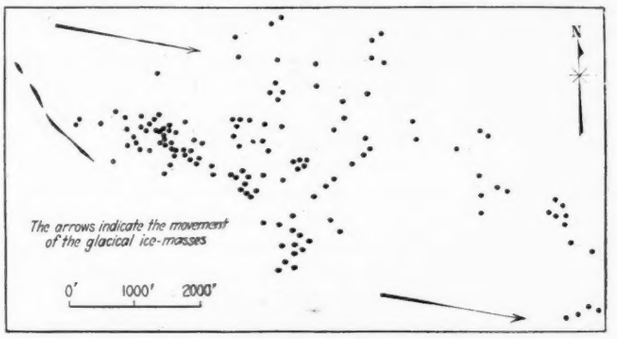


COPPER PLANT AT OUTOKUMPU USING THE HYBINETTE PROCESS

War and want of capital have thus far hampered the development of the copper industry in that district, but there is no doubt that this great ore deposit, which is capable of a yearly production of at least 6,000 tons, will be in the future an important source of revenue to Finland. Reporting on the mine in a professional capacity, Prof. J. H. L. Vogt has said that he is confident that this property alone will reimburse to the government all the expenditures of the Geological Survey of Finland. The bureau will thus prove to be a directly paying enterprise. It seems not unlikely that more orebodies of the same character may be found.

In the same zone of rocks where these pyritic ores occur, small deposits of pyritic ores of a less reliable character are often found in the metamorphic basic rocks. Some of them, occurring in veins sharply cutting the main rock with a filling of calcite or quartz, may occasionally carry copper pyrite, but they are always irregular, and others forming small indefinite seams in the basic rocks are only prospects of a wildcat character.

Deposits of iron pyrites occur at several places in eastern Finland. The most important is that of Otravaara, twenty miles from the railway between Sordavala and Joensuu. The ore has a thickness of 20 ft. and is of fair degree of purity, with 40 to 47 per cent sulphur. Another deposit of pyritic ore is that of Tipasjärvi, east of Kajana, and of Jalonvaara, in Suis-



SPREADING OF THE ERRATIC BOULDER FROM THE DEPOSIT OF IRON PYRITE AT JALONVAARA

tamo, north of Lake Ladoga. The last mentioned was discovered in 1920 by Dr. P. Eskola, in charge of the Geological Survey, and lies at a distance only eight miles from the nearest railway. The map shows the spreading of the erratic boulders from this ore deposit, indicating that it has a much greater length than the portion which the diamond drilling has hitherto detected. It is probable that these iron pyrite deposits, together with the ore of Outokumpu, will fill the sulphur requirements of the Finnish pulp and paper industry, as well as those of the chemical industry, so that no imports of sulphur or pyrite will be necessary. None of these deposits of iron pyrite is situated favorably for export.

In the Petsamo (Petchenga) area, at the coast of the Arctic Ocean, a territory Finland acquired when concluding peace with Soviet Russia, veins of galena occur, some of which have a thickness of several inches. They are often well mineralized and contain some sphalerite. The galena is in part argentiferous. The gangue consists of quartz or calcite. Various competent authorities have given favorable reports on these veins, but thus far only research pits have been opened.

Lead Ore Found, but of Small Importance

In Finland proper some galena has been mined at Pitkäranta and Orijärvi, where the probable quantity of the remaining ore has been estimated to be 400,000 tons. A few miles from the latter mentioned mine there is a quartz vein containing a low percentage of lead, together with some gold. It was worked during the war, but is now lying idle. Also, in the "rapakivi" granites of Finland narrow veins of galena occur, but they possess no economic importance.

In 1836, a boulder of dolomite containing native gold was found near Kemi, at the northern end of the Gulf of Bothnia. Despite long-continued and reiterated research, it has not been possible to trace its origin. In 1860, however, placer gold was found at the River Ivalojoki, in northern Lapland, southwest of Lake Enare. Since that time gold has been won in Finland mainly from gravel beds in the narrow valley of the River Ivalajoki and its tributaries which

PRIMITIVE GOLD SLUICING AT SOTAJOKI, TRIBUTARY OF IVALAJOKI, IN FINNISH LAPLAND

were rich in water at the close of the Glacial Period, and also from fissures in the underlying bedrock, which is hard and unweathered. At the beginning of operations hundreds of men worked there every summer, but now the work is inconsequential. Altogether, gold to a value of about $300,000 has been won during half a century.

Gold Placers Being Worked

A great part of the placer gold is rather coarse, and it is probable that most of the finer gold particles have accumulated below the eastern end of the present narrow river valley, where there are large deposits of river sand laid down during the Glacial Epoch. As the course of the glacial river has probably changed often, and as the underlying bedrock has a rugged surface, it will be difficult to find out where richer deposits may possibly have accumulated, and, if they are found, to work them with the aid of dredges or other machinery. Attempts have been made to win the gold from the deepest parts of the present river bottom, but great difficulty is caused by the rugged character of the surface of the crystalline rocks.

In some of the small tributaries of the Ivalo River the gold is coarse and very little waterworn, forming beautiful feather-like crystals, often combined with quartz and limonite. However, it was only in 1900 that a Finnish miner, who had returned from the United States, succeeded in finding gold in a vein of quartz and limonite, in which the ore occurred as feathery crystals similar to those occurring in the gravel of the river in the neighborhood. He started his work at the contact of a dike of syenite cutting pegmatitic quartz. The gold-bearing veins occurring occasionally at the same place were intermediate in age. It is probable that the ore formed a small although rich pocket in the vein, but deeper below in the same brecciated zone the contents were low.

During the following years effective prospecting was done by several concerns, and a great number of veins were found, consisting in their upper part mainly of limonite and blue quartz. There were many signs of weathering of the upper portions of the veins and redeposition of the gangue minerals of the neighboring country rock, and as it was thought that the limonite portions were the gossan of pyritic veins, it was held probable that there might be a zone of secondary enrichment deeper below. But at a depth of a hundred feet or less the vein filling was found to consist only of calcite, dolomite, siderite, and quartz, with only small amounts of pyrite. If there has been a secondary enrichment, which is possible, it has probably occurred mainly during the weathering of those portions of the veins which are now almost completely destroyed. All the veins hitherto examined were extremely poor, and generally carried only traces of gold. Also, if richer pockets were found, it is probable that most of the veins are not workable.

Rare Metals and Non-Metallics Represented

Platinum and iridium have been found in small quantities together with the placer gold of Lapland. They are thought to be derived from the same veins as the gold, but it seems more likely that they originally occurred in peridotitic rocks which are not uncommon in the region.

Molybdenite occasionally occurs in granite veins in Finland, usually in small quantities. They have been worked at only one place, Mätäsvaara, in eastern Fin-

land, north of Joensuu. Radio-active minerals have been found at some places near Lake Ladoga, but thus far they have not been worked on a commercial scale.

At Lake Siama, metamorphic peridotites are known which contain amphibolitic asbestos. The mineral is rather brittle, is difficult to separate from the other constituents, and does not form veins, but is disseminated through the whole rock mass. It may easily be won in great quantities.

Graphite has been found at several places, usually as layers in schists, or disseminated between their minerals. The most important occurrences are in Tyrvää and are owned by O. Y. Grafit, A.B., which has built a concentration plant.

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Crystalline limestone occurs in several places in northwestern Finland in great quantities and good quality, and has been used also for producing a cement of superior quality.

Volatilization Experiments on Low-Grade And Complex Ores

The application of the chloride-volatilization process to the recovery of metals in low-grade and complex ores continues to be one of the major problems being studied at the Intermountain Experiment Station of the U. S. Bureau of Mines at Salt Lake City, Utah. The process consists of crushing to the proper fineness; mixing with chloridizing agents, such as sodium and calcium chloride, alone or with other reagents; furnacing at elevated temperatures to effect chloridization and volatilization of the metal chlorides formed, and treatment of the volatilized chlorides to obtain the valuable metals in salable form. Electrical precipitation is considered the most feasible way of collecting the volatilized fume.

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The treatment of the collected fume continues most important, as the fume from each ore is a problem in itself. A laboratory-size reverberatory furnace for the reduction of lead and copper chloride fumes has been constructed to determine whether continous feed can be employed without excessive loss by volatilization. During test runs, by the use of this furnace careful control of the temperatures, keeping them below 1,150 deg. F., eliminated much of the loss by volatilization. Investigations were made to determine the feasibility of introducing the metallic chloride fumes through the side of the furnace underneath the surface of the slag, and these experiments proved to be successful. The small-scale laboratory experiments indicate practically a complete reduction of lead and copper fumes.

The volatilization process is best suited for low-grade oxidized ores of copper, lead, silver, and zinc, and also for the more complex oxidized ores of these metals. Practically complete extractions of lead and copper have been obtained, and the extraction of silver has been from 50 to 90 per cent. Copper ore carrying copper mainly in the form of chrysocolla is difficult to volatilize. The volatilization process seems to be particularly adapted to separating lead and silver from zinc in oxidized ores. The work is being conducted by Thomas Varley, metallurgist, and E. P. Barrett, metallurgical chemist, for the Bureau of Mines, and C. C. Stevenson and Virgil Miller, of the research department of the University of Utah.

Studies in the chemistry of the volatilization process have been made by C. M. Bouton, physical chemist, to determine the chemical reactions involved and the vapor pressure of sodium chloride.

Experimental work in co-operation with the Ontario Silver Mining Co., of Park City, Utah, on low-grade complex ore carrying silver, lead, and zinc, is also being continued by the Bureau of Mines. Practically a complete extraction of the silver and lead has been obtained. Experimental work was carried on with the Yellow Pine Mining Co. at its fifty-ton plant in Goodsprings, Nev., but was discontinued on account of a temporary closing of the plant. As this was the first attempt of the Bureau to employ the volatilization process on a commercial scale, valuable data were obtained.

In tests conducted in co-operation with M. P. Kirk, at a plant in Harbor City, Cal., a high-grade zinc oxide has been made direct from zinc-carbonate ore. Volatilization tests of ores carrying less than one-half of 1 per cent lead gave complete volatilization of the lead. The experiments were successful, and Mr. Kirk plans to erect a larger and more complete plant at or near Harbor City, where volatilization will be employed on a commercial scale. Many other volatilization experiments have been conducted with various mining companies on different types of ores, to ascertain whether the volatilization process could be used. A bulletin covering the volatilization process in detail is in course of publication.

Willow Creek District Examined By Bureau of Mines

The Federal Mine Inspector for Alaska, whose work comes within the supervision of the U. S. Bureau of Mines, recently made an investigation of the Willow Creek mining district in that territory. This district has every indication of being a fairly active one in the near future. All veins that have been seen so far are true fissure veins, carrying free gold. The veins vary from a few inches to several feet thick and carry gold values from $5 to $200 per ton. The average value of the ore now worked is about $50 per ton. This district is about twenty-five miles north of the town of Wasilla, on the Government railroad.

Notes on Lead-Bullion Refining— A Correction

In the article "Notes on Lead-Bullion Refining" which appeared in the issue of Dec. 17, 1921, under the caption "Reverberatory Byproduct Furnace," is the statement: "These two methods give silver which is free from antimonial slag." It should read: "These two methods give silver-free antimonial slag."

The Burden of Mine Taxation—Its Special Problems

Necessity for Reduction of Governmental Expenditures, for the Right Popular Understanding of the Status of the Mining Industry, and for a Fair Apportionment Of Annual Tax Assessments Between Mines and Other Industrial Developments

BY HENRY B. FERNALD*
Written for *Engineering and Mining Journal*

TAXATION now imposes an unusually heavy burden on the mining industry; first, because there is a great common load of taxation which must be borne by industry today—by the mines, as well as by all other industries of the country; and, second, because there are certain conditions peculiar to mines which vitally affect the taxes which the mining industry must pay.

The first of conditions noted is really the more important. If the aggregate amount to be raised by taxation is small, it should not fall with burdensome force upon any one industry. One may pay slightly more, and another slightly less, than its fair share of government expenditures. Furthermore, if there do prove to be inequities, it is a relatively simple matter to work out such modifications and changes as may be necessary to give each taxpayer a fair measure of relief. If, however, the amount to be raised by taxation is so large that it cannot help but be a burden on all industry, the various differences which were formerly negligible become matters of vital importance, and the greater the amount to be raised by taxation, the harder is it to make the readjustment to give proper relief from an unfair or inequitable impost.

THE COMMON TAX BURDEN

The common burden on industry arises from certain fundamental sources:

1. DEVELOPMENT AND GROWTH OF GOVERNMENT EXPENDITURES

(*a*) *Federal Expenditures*—The dominating feature of Federal expenditure is, of course, payment for the Great War. The interest on our war debt amounts each year to more than our annual pre-war Federal budget, and the principal must sooner or later be paid off through taxation. Furthermore, we are still having to pay, year by year, a great amount to clear up obligations and commitments which arose from the war, and to maintain an organization to consider and handle these post-war settlements. This accounts for a large part of our increased burden of Federal taxation. Our debt expenditures must continue for years, but we should be able materially to reduce Federal expenditures by elimination of those which are now being made to clear up the war situation.

There are, however, three other important features of increased Federal expenditure. One is that the entire Government organization was geared to a war basis. In war matters the important purpose was that of accomplishment, almost regardless of expense, and it was unavoidable that something of this same spirit should be applied to the peace-time departments. This is not surprising, as much this same condition existed in the industrial concerns of the country. It is not an easy matter, and it is going to take time, for the Government to get back to a normal basis. Real efforts for the accomplishment of this important objective are being made in Washington and should ultimately result, under the present Federal budget system, in a more economical and businesslike administration of Government affairs than the country possessed even in pre-war days.

Another and perhaps more serious feature is the continually increasing extent to which the Federal Government is being urged to take over or to assist in what were formerly regarded as purely state activities. If this merely involved that expenditures heretofore made by the states were in the future to be made from the Federal treasury it would not denote any increase in the aggregate tax burden of the country, but the usual tendency of, and in many cases the arguments for, the Federal expenditure is to have the states make greater expenditures for these same purposes. The additional amounts which must be raised by the Federal Government do not, therefore, serve to decrease, but rather operate to increase, the amounts which must be raised by the states. This statement may properly be made without implication of criticism of the merit of the expenditures.

Perhaps with the increasing population and development of the country it is necessary that both Federal and state expenditures for many of these purposes should be augmented, and if such increase were only proportionate to the expansion in wealth of the country, it would not necessarily involve an addition to the tax burden. The tendency in recent years, however, has been for these expenditures to grow much more rapidly than the increase in wealth, as is evidenced by the continually advancing tax rates. Perhaps it is unavoidable that there should be this enlargement in both Federal and state expenditures and that they should expand much more rapidly than does our national wealth. If so, we must count on a continually increasing tax burden upon industry, at least until we reach what might be termed the "point of saturation." This is a rather pessimistic assumption, because it would lead to the conclusion that the growth and development of the country would produce a constantly increasing tax burden until that burden became so oppressive as to check and retard further development.

A third feature, and one similar to that just mentioned, is the constant demand that the Government should assume entirely new functions or should greatly expand existing activities. Some of these are merely political maneuvers, with little, if any, justification. The majority, however, have some merit. Sometimes the trouble is that, to accomplish some good end, an expensive, elaborate or even impracticable scheme is devised and expenditures are authorized under the urge of enthusiasm for the project proposed. Sometimes the purpose, though worthy in itself, is one which is really not a proper Federal activity but should be left to the states, to the municipalities, or to private

*Of Loomis, Suffern & Fernald, New York.

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In tests conducted in co-operation with M. P. Kirk, at a plant in Harbor City, Cal., a high-grade zinc oxide has been made direct from zinc-carbonate ore. Volatilization tests of ores carrying less than one-half of 1 per cent lead gave complete volatilization of the lead. The experiments were successful, and Mr. Kirk plans to erect a larger and more complete plant at or near Harbor City, where volatilization will be employed on a commercial scale. Many other volatilization experiments have been conducted with various mining companies on different types of ores, to ascertain whether the volatilization process could be used. A bulletin covering the volatilization process in detail is in course of publication.

Willow Creek District Examined By Bureau of Mines

The Federal Mine Inspector for Alaska, whose work comes within the supervision of the U. S. Bureau of Mines, recently made an investigation of the Willow Creek mining district in that territory. This district has every indication of being a fairly active one in the near future. All veins that have been seen so far are true fissure veins, carrying free gold. The veins vary from a few inches to several feet thick and carry gold values from $5 to $200 per ton. The average value of the ore now worked is about $50 per ton. This district is about twenty-five miles north of the town of Wasilla, on the Government railroad.

Notes on Lead-Bullion Refining— A Correction

In the article "Notes on Lead-Bullion Refining" which appeared in the issue of Dec. 17, 1921, under the caption "Reverberatory Byproduct Furnace," is the statement: "These two methods give silver which is free from antimonial slag." It should read: "These two methods give silver-free antimonial slag."

The Burden of Mine Taxation—Its Special Problems

Necessity for Reduction of Governmental Expenditures, for the Right Popular Understanding of the Status of the Mining Industry, and for a Fair Apportionment Of Annual Tax Assessments Between Mines and Other Industrial Developments

BY HENRY B. FERNALD*
Written for *Engineering and Mining Journal*

TAXATION now imposes an unusually heavy burden on the mining industry; first, because there is a great common load of taxation which must be borne by industry today—by the mines, as well as by all other industries of the country; and, second, because there are certain conditions peculiar to mines which vitally affect the taxes which the mining industry must pay.

The first of conditions noted is really the more important. If the aggregate amount to be raised by taxation is small, it should not fall with burdensome force upon any one industry. One may pay slightly more, and another slightly less, than its fair share of government expenditures. Furthermore, if there do prove to be inequities, it is a relatively simple matter to work out such modifications and changes as may be necessary to give each taxpayer a fair measure of relief. If, however, the amount to be raised by taxation is so large that it cannot help but be a burden on all industry, the various differences which were formerly negligible become matters of vital importance, and the greater the amount to be raised by taxation, the harder is it to make the readjustment to give proper relief from an unfair or inequitable impost.

THE COMMON TAX BURDEN

The common burden on industry arises from certain fundamental sources:

1. DEVELOPMENT AND GROWTH OF GOVERNMENT EXPENDITURES

(*a*) *Federal Expenditures*—The dominating feature of Federal expenditure is, of course, payment for the Great War. The interest on our war debt amounts each year to more than our annual pre-war Federal budget, and the principal must sooner or later be paid off through taxation. Furthermore, we are still having to pay, year by year, a great amount to clear up obligations and commitments which arose from the war, and to maintain an organization to consider and handle these post-war settlements. This accounts for a large part of our increased burden of Federal taxation. Our debt expenditures must continue for years, but we should be able materially to reduce Federal expenditures by elimination of those which are now being made to clear up the war situation.

There are, however, three other important features of increased Federal expenditure. One is that the entire Government organization was geared to a war basis. In war matters the important purpose was that of accomplishment, almost regardless of expense, and it was unavoidable that something of this same spirit should be applied to the peace-time departments. This is not surprising, as much this same condition existed in the industrial concerns of the country. It is not an easy matter, and it is going to take time, for the Government to get back to a normal basis. Real efforts for the accomplishment of this important objective are being made in Washington and should ultimately result, under the present Federal budget system, in a more economical and businesslike administration of Government affairs than the country possessed even in pre-war days.

Another and perhaps more serious feature is the continually increasing extent to which the Federal Government is being urged to take over or to assist in what were formerly regarded as purely state activities. If this merely involved that expenditures heretofore made by the states were in the future to be made from the Federal treasury it would not denote any increase in the aggregate tax burden of the country, but the usual tendency of, and in many cases the arguments for, the Federal expenditure is to have the states make greater expenditures for these same purposes. The additional amounts which must be raised by the Federal Government do not, therefore, serve to decrease, but rather operate to increase, the amounts which must be raised by the states. This statement may properly be made without implication of criticism of the merit of the expenditures.

Perhaps with the increasing population and development of the country it is necessary that both Federal and state expenditures for many of these purposes should be augmented, and if such increase were only proportionate to the expansion in wealth of the country, it would not necessarily involve an addition to the tax burden. The tendency in recent years, however, has been for these expenditures to grow much more rapidly than the increase in wealth, as is evidenced by the continually advancing tax rates. Perhaps it is unavoidable that there should be this enlargement in both Federal and state expenditures and that they should expand much more rapidly than does our national wealth. If so, we must count on a continually increasing tax burden upon industry, at least until we reach what might be termed the "point of saturation." This is a rather pessimistic assumption, because it would lead to the conclusion that the growth and development of the country would produce a constantly increasing tax burden until that burden became so oppressive as to check and retard further development.

A third feature, and one similar to that just mentioned, is the constant demand that the Government should assume entirely new functions or should greatly expand existing activities. Some of these are merely political maneuvers, with little, if any, justification. The majority, however, have some merit. Sometimes the trouble is that, to accomplish some good end, an expensive, elaborate or even impracticable scheme is devised and expenditures are authorized under the urge of enthusiasm for the project proposed. Sometimes the purpose, though worthy in itself, is one which is really not a proper Federal activity but should be left to the states, to the municipalities, or to private

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enterprise. Sometimes the project possesses some merit, but the expenditure required is all out of proportion to any real good to be achieved. In almost every instance these projects will have the support of some honest and enthusiastic individuals and organizations, and the pleas of enthusiastic men and women will often obtain an appropriation regardless of expense or practical considerations.

We must regain our sense of financial values which we lost in the period of inflated values and vast Government expenditures, unless we are to accept the pessimistic view already mentioned, that our tax burden must continually increase and bring about its own natural consequences. This conclusion is not inevitable, because we have already witnessed some effect of the demand for a reduction in Government expenditures, and if there is a general realization that increased expenditures, regardless of their merit or importance, will make necessary the raising of still greater amounts by taxation, we can and should devise a check on the tendency continually to add new activities and to expand existing activities of the Government.

(*b*) *State Expenditures*—Much the same condition exists with respect to state as to Federal expenditures. The states have not had to raise money for direct war expenditures, but they have undertaken many additional activities on account of the war. There has also been created a loss of perspective because of the vast sums that the Federal Government was spending.

A similar tendency of states to take over or to aid in activities which had previously been considered county or municipal matters is to be noted. There has also been created a feeling that the state must spend every dollar necessary to obtain such Federal aid as was contingent upon state expenditure, often regardless of the merit of the project and often careless of the method of expenditures and neglectful of the results to be achieved. New activities have been introduced and former activities expanded in much the same manner as for the Federal Government. The insistent search for new sources of revenue and the increased tax rates in practically all of our states show how far the state expenditures have outstripped the increase in their wealth.

(*c*) *County and Municipal Expenditures*—County and municipal governments have been subject to similar pressure to increase and expand their activities, and in general have done so at a rapid rate. The full extent of their additional activities is not always reflected in the increased tax rate, because of the extent to which they have been able to transfer their former functions. Such a transfer does not usually result in reduction of local taxation, because other activities absorb the apparent saving. In fact, the fundamental motive is generally to enable the towns and counties to have this money available for some other purpose rather than to enable them to effect a reduction in the tax rate.

There exists, apparently, a belief that the local taxpayer puts up the money for town and county expenditures, but that it is someone else who pays for the expenditures made by the state. It is true that the state taxes may not fall with the same force on local taxpayers as do those of the town and county, and therefore it may also be true that in any particular town or county the taxpayers contribute less toward the cost of certain activities if these are conducted by the state than if they were under the direction of the town or county. An increased tax burden must, however, be borne somewhere within the state. Under some conditions the larger scale of operations under state administration should enable them to be conducted more economically, but this is probably offset by the greater demands for such expenditures which arise when the taxpayers do not see so clearly that it is their own money which is being spent. It can almost be accepted as an axiom that the closer expenditures are to the source of revenue, the more closely will the taxpayers watch the nature and result of the expenditures.

This matter of Government expenditures is the fundamental factor in the tax situation today. Were our Government expenditures low, there should be no special tax burden upon the mines. If we could go back to the old Federal tax of 1 per cent on income, and the old rates and assessments for local taxes, it would not be a matter of great importance whether or not mines paid slightly more or less than their fair share of the general tax burden.

2. POPULAR SENTIMENT REGARDING TAXES

A real problem to be met is the popular sentiment that industrial corporations represent great wealth, presenting unlimited tax possibilities. In response to popular demand a shifting of the tax burden has been effected. Step by step, the taxes on corporations and wealthy individuals were increased. In pre-war days this had no real detrimental effect on business, because governmental expenditures were not so large and the tax rates, as we now realize, were low. Even as late as 1916 the Federal income tax on corporations was only 2 per cent and the maximum tax rate on individuals was 15 per cent. We had not then reached the point where such taxation became great enough to have any marked influence on business and investment policies and decisions.

In as complicated a financial and industrial situation as that through which we have been passing, we cannot attempt to define the exact extent to which business has been influenced by taxation. We know it has been affected, because billions of dollars in taxes cannot be taken from the profits of industry without having an oppressive effect. We also know that business managers and large investors are materially influenced as to policy and decisions by the tax situation. This fact, however, has not been understood or appreciated by the popular mind. Political agitators can enthuse their audiences more on a text of "soak the corporations" than economists can in presenting the facts to show that the continually increasing volume of Government expenditures is a burden which falls not alone on the wealth of industry, but which affects everyone concerned with its processes and products. This psychological factor particularly affects the mines, which embody, in popular conception, emblems of great spectacular wealth and therefore easy targets for taxation. The ordinary manufacturing or trading business does not stand out with the glamour which attaches to the successful mine. One of the greatest problems the mines have to solve is how to meet this psychological factor so that a fair hearing and just decision may be accorded their tax problems. These are the conditions which give rise to the common tax on industry, and the mining industry can expect no material re-

duction in the tax burden which it must carry unless it can do its part in solving these fundamental problems.

TAXATION OF MINES

The various forms of taxes to which the mines are subject each presents its own special feature of the general problem. Each separate mine will also have some problems peculiar to itself. One of the greatest difficulties in the entire tax situation is the question of how the individual mine should handle its affairs so that it will not subject itself to higher taxes than it ought equitably to be required to pay.

If we could set up a tax bill for all the time which has been given, and is today being given, by mining companies to the solving of the problem presented by the Federal tax situation alone, the result would amount to an astounding total. One reason for this has been the frequent changes in our taxing laws. Every change in basis of taxation presents a new problem for solution, and before urging any such change we ought carefully to consider what it is going to cost the business men of the country to solve the new problem which will thus be presented. Considering briefly the principal forms of taxation applied to mines, the following may be mentioned as the main problems presented:

Federal Income Tax—So far as mining corporations are concerned, their principal problems under the Federal income tax laws relate to the past rather than to the present or future. Although the excess profits tax was not officially repealed until 1922, there are only a few mines that have any cause for worry regarding their 1921 taxes.

Those who framed the new Revenue Law have tried to be fair to the mining corporations. They, as other corporations, are subject to only a 12½ per cent income tax. Depletion deductions are allowed on substantially the same basis as in the prior law, although there has been included the relatively minor provision that depletion based on discovery shall not exceed the year's income from the property, and also that depletion based on discovery value is not to give rise to a loss to be carried forward against a subsequent year. No substantial change was made in the provisions regarding depreciation, obsolescence, and inventories. Of course, no law can be drafted and no regulations can be established by the department which will not weigh heavily in some particular applications, but it seems the manifest intention of the law and of the department that mines should receive fair recognition for the wasting of their assets and should not be at a disadvantage on that account as compared with the other industries of the country.

From the standpoint of stockholders, more definite recognition is given in the law to the non-taxable character of distributions which come from the proceeds of depletion, although the law is made even more specific that such distributions can be made only after first distributing any profits accumulated since March 1, 1913; but this is only the same rule which applies to dividends by any corporations. The high surtax rates on individuals will have some detrimental effect on mining, as on other industrial investments, because it is so manifestly to the advantage of individuals with large incomes to place their funds in tax-exempt securities. On the other hand, the provisions for a reduced tax on "capital gains" is a distinct benefit and should generally remedy the situation where the sale of stock ownership of a mining property was prevented because of excessive taxes which the seller would have to pay on profits which he realized.

An important provision in the new law is that which allows losses in one year to be deducted from taxable income of the succeeding year. This is particularly important to mining companies, because mining is a "rich or poor" business. The wording of the law giving this relief is rather complicated and perhaps subject to some criticism of the way in which the matter is worked out, but, after all, the fact of primary importance is that corporations are given this relief, and for mining companies that depletion based on cost or value at March 1, 1913, is definitely recognized as a deduction in computing such a loss, although depletion based on an increased discovery value is excluded. This allowance to the corporation does not give relief to mining stockholders, and they will, therefore, be subject, as in the past, to assuming, perhaps, a high tax rate in years of large dividends, with no compensating factor for those years in which no dividends may be received.

The old problems raised by the 1917 and 1918 laws are not yet settled, and for some time will probably be the largest Federal income tax problems which mining companies have to resolve. Most of the questions which can arise seem, however, to have been well covered by the Treasury Department, and fortunately there is evidence of a definite intention on the part of the department to accord to future cases any rights which have been established in cases already settled. It is needless to say that there can be no fair and just settlement of mining tax issues under the excess profits tax law, because the provisions of invested capital were essentially unfair to the mining industry. Each mine will have its own problems in this regard, but these are problems of the past, which, when once settled, we can believe will never recur.

Federal Capital Stock Tax—The capital stock tax continues in substantially its present form, with a tax of $1 per thousand on "the fair average value of its capital stock for the preceding year." The question of how this "fair average value" is to be determined is one not yet fully clarified. With the capital stock tax thus recognized as a continuing feature of our revenue laws, more definite progress should be made in resolving this question than was made when it appeared that this tax would probably be abolished. In a period of prosperity the capital stock tax is not a particular burden, because it is relatively small as compared with the income tax, but in time of depression it becomes a material burden, because it still has to be paid, even though the corporation is operating at a loss and has no income tax to pay.

Other Federal Taxes—There are various stamp and excise taxes which, directly or indirectly, have to be borne by the mining industry, but only in the same manner in which they must be paid by the other industries of the country. Mines were particularly burdened with the transportation tax, but with its repeal the other items can hardly be classed as a special problem for the mines, although in some particular instances they may be of importance.

State Taxation—It is more difficult to set forth the specific problems which arise in state taxation, because each of our separate states presents its own problem. In all states there is a general demand for increased revenues. The mining industry is in a period of

serious depression. For political reasons, the states hesitate to seek additional revenues from the farming communities or from general business. Mines stand out as particular targets; they do not have the voting power which the farmers have, nor the political influence of the retail dealers. There is no fear of their moving their mines out of the state, and, as already mentioned, to the popular mind they represent unlimited wealth. A further popular belief is that the mines are robbing the state of its wealth as they ship out the mineral products.

There has not been sufficient appreciation of the narrow margin between gain or loss which exists in most mining operations and of the vast amounts which the mines spend or cause to be spent locally. The most successful mines in their most successful years stand out as the basis for comparison, although they present an entirely false picture of the average for any one mine, to disregard completely the average for the entire mining industry. A popular belief has been created that mines have had an unmerited prosperity because they have been leniently dealt with by the states, and the fact that the mining states have reached their present stage of prosperity and development only through the vast sums which have been spent on mining development, because the opportunity for large gain to a few mines in certain periods was enough inducement to offset the strong probability of loss, has been ignored. One of the biggest problems which the mines have to face today is to meet a certain adverse public opinion which undoubtedly exists and to give to the public the right appreciation of what the mining industry is and its relations to the general business and public welfare.

Two principal systems of state taxation of mines have been evolved, although these assume many and varied forms. One is the assessment of mining property as realty in the same general manner as other real property of the state. This brings up the problem as to a basis of assessment of mining property which will be comparable with assessments of farming and business properties, because when the assessment is determined the tax burden will be spread according to the assessed valuation.

The other basis is that of a tax based upon volume of output or amount of profits. This, then, raises the question as to what rate of taxation should be applied to the profits or the output, to have the mines stand their fair share of the aggregate total raised by taxation.

In neither of these contingencies is it easy to say what is the right comparative basis. If the basis of valuation as real property is used, we are confronted with the fact that a large part of the value of a mine is represented by ores which cannot be reached for years to come and which have little, if any, effect upon the amount of present income out of which the taxes must be paid, so that mines are radically different from other properties which have only a surface value, which is available for present use. If, on the other hand, mines are taxed on a basis of output, we have the problem of determining what should be the rate of taxation applied thereto. It is a difficult matter to determine whether a tax amounting to a certain percentage of the profits of the mine (or of its net proceeds) or a tax of a stated amount per ton is or is not fair as compared with the basis of assessment and rate of tax applied to other property in the state.

The problem is more complicated because we cannot divorce the mining question from the other features of revenue and taxation in the various states. We may take any one state and determine what would seem a fair and just solution there, but as soon as we turn to another state we find that the whole nature and fabric of the revenue and taxation structure of state, counties, and municipalities is so different that we must start anew to find our right solution. We are also confronted with the practical question that popular ideas and opinions vary in the different states, and a solution which may be adopted in one state might be entirely unacceptable to the people of another. Perhaps some day we may evolve a uniform basis in all states, but we cannot expect this to be possible until we can work out for all the states a more uniform basis of revenue and taxation and create a more uniform popular conception of how government revenues should be raised and spent.

County and Municipal Taxes—County and municipal taxation presents much less of a problem to the mines. Usually, the mining community has mining as its one dominant industry, so that the mine or mines must bear the bulk of local taxation. If a mine has to bear substantially all the local taxes, it makes little difference how they are levied. If the assessment is high, the tax rate should be low, and vice versa. It is only when we proceed to raise revenue jointly from mining and from other property, as we do by state taxation, that the question of valuation of the property and rate of tax becomes a serious problem. The dominant considerations in state and local taxation are, therefore, that the local government expenditures should not be excessive and that the basis used should not be such as would make it appear to those not acquainted with the situation that the mines were not bearing their fair and equitable share of the tax burden imposed upon industry.

This paper summarizes only briefly some of the main features of the situation. Any one division of the subject might be greatly expanded and many other problems discussed with profit. We might also consider those taxes which fall on railroads, power companies, and other activities auxiliary to the mining operations. The main features, however, seem to be those mentioned herein: The reduction of government expenditures, the creation of an accurate popular conception of the status of the mining industry, and the fair apportionment of the tax burden as between the mines and the other industries of the country.

Microscopic Investigation of Tintic Standard Ore

Microscopic work on concentration products of the Chloride, Ariz., ore has been completed at the Intermountain Station of the U. S. Bureau of Mines, with the exception of the work involved in the preparation of photomicrographs.

A preliminary microscopic study on the iron box sludge and other products obtained from chloridizing, roasting and leaching of ore from the Tintic Standard mine indicates that the problem involved in the elimination of the arsenic and other impurities is a strictly chemical one and that microscopic work may help in determining the physical condition of some of the components of the sludge.

Calculation of Anode-Furnace Charges in a Copper Refinery

First Consideration Is To Get the Blister Richest in Precious Metals Through the Operation in Shortest Possible Time—How The Presence of Impurities Governs the Composition of the Charge

BY C. M. BRISTER, JR.
Written for *Engineering and Mining Journal*

"GET THE SILVER and gold into the anodes as quickly as possible" is the governing principle for the copper refinery. Every day that the precious metals are locked up in the pig copper means a real loss to the plant in the interest on the money value. Once in the anodes, a start, at least, is made on the road to final shipment as refined metal. Plants doing custom work are required by their contracts to deliver the silver and gold received in pig copper to the owners within a certain specified time—usually about two months after receipt. The refinery must deliver the goods on the specified date or transfer the money equivalent to the owner.

Some one man must keep the bullion moving, therefore, and calculate the anode-furnace charges, to assure that the richer blister copper is given first place in the mixture. The procedure described in this article is that practiced by a large copper refinery in this country.

EQUIVALENT SILVER IN VARIOUS BRANDS IS RECORDED

For quick comparison of the various grades of copper received, a list showing the "equivalent silver" of each brand is kept up to date by use of the latest assays available. The term is simply a figure showing the value of the precious-metal content of the blister, considered as all silver. That is, with gold at $20 per troy oz. and silver at $1 per oz., the equivalent silver for pig copper assaying 0.5 oz. gold per ton, and 25 oz. silver per ton, will be $0.5 \times 20 + 25 \times 1 = \$35$.

ASSAY OF VARIOUS HYPOTHETICAL BRANDS

Brand	Gold, Oz. per Ton	Silver, Oz. per Ton	Equivalent Silver, Value in Dollars per Ton
A	4.50	630	720
B	0.80	400	416
C	1.00	150	170
D	0.65	67	80
E	0.98	55	75
F	1.00	40	60
G	0.85	2	19
H	0.15	13	16

A copy of this list is sent to the anode-furnace superintendent for his guidance. If "G," for example, appearing on his charging instructions, is not available for any one charge, he will consult the table and substitute the brand highest in value and which is not carrying more impurities than "G."

This table is brought up to date once a month, with the aid of the average assays of each brand received during the month. The variation in value and percentage of impurities for any particular blister is usually slight, so that if a high-grade lot comes in and no provision is made for it on the current charge, it can be immediately taken care of by using the analysis and assays of the preceding month. It must be drilled for the sample, but it is not necessary to wait for the assay of the sample. In the treatment of blister which varies widely from month to month, a hurried drill sample is usually taken to check the assumed assay values, whenever a new lot comes in.

The factors other than equivalent silver which affect the choice for the charge are:

1—Impurities. Typical analyses of the ten brands enumerated in the equivalent silver table may be:

Assay in Per Cent

Brand	Lead	Nickel	Arsenic	Antimony	Selenium	Tellurium
A	0.550	0.525	1.425	0.440	1.350	0.540
B	0.330	0.430	0.370	0.230	0.030	0.008
C	1.800	1.140	0.310	0.460	0.032	nil
D	0.025	0.067	0.002	0.070	0.020	0.007
E	0.004	0.058	0.001	0.002	0.035	nil
F	0.010	0.014	0.004	0.003	0.015	0.010
G	0.009	0.030	0.010	0.013	0.030	0.012
H	0.008	0.042	0.020	0.055	0.007	nil

The impurities in a particular brand of pig copper usually run fairly uniformly, and in most operations there are one or two impurities which will limit the amount of that brand to be placed in the anode charge. The copper having the highest equivalent silver is used up to the limit of the amount of impurities the charge will stand.

All reports within the plant show the "Stock on Hand" and other pertinent information of each brand, in tons. It greatly facilitates calculations, therefore, to have the impurities listed as *pounds per ton*, instead of in per cent. A loose-leaf record is kept with a separate sheet for each impurity, as follows:

NICKEL IN PIG COPPER
In Pounds, Per Ton

Brand	Average Aug.-Jan.	January	Average Sept.-Feb.	February	Average Oct.-March	March	Average Nov.-April
A	10.50	.....	10.50	....	10.50	10.50	10.50
B	8.00	7.50	7.92	8.20	7.95	8.60	8.06
C	45.00	22.60	26.33	....	26.33	22.80	25.74
D	1.20	1.20	1.20	1.28	1.21	1.35	1.23
E	1.30	1.44	1.32	1.38	1.33	1.16	1.30
F	0.28	....	0.28	....	0.28	0.28	0.28
G	0.60	0.58	0.60	0.62	0.59	0.60	0.60
H	0.98	1.02	0.99	1.02	1.00	0.84	0.98

The average column shows the average value for the last six months. It is a most convenient figure to have when a lot of high-grade copper arrives in the middle of a period, for it can be used in calculations of a new charge until more accurate figures are available.

The allowable limits of impurities in the anodes depend upon the pig copper available for use. The permissible limits may be as listed below:

ALLOWABLE LIMITS OF IMPURITIES IN ANODES

Element	Maximum, per Cent	Minimum, per Cent
Gold	.....	0
Silver	225 oz. per ton	0
Lead	0.150	0
Nickel	0.155	0
Arsenic	0.150	0
Antimony	0.120	0.08
Selenium	0.10	0
Tellurium	0.05	0

It is not good practice to have the results of the charge calculations show the maximum figure for more than two impurities on the same charge. There are impurities present, of course, other than those listed, but

their importance is negligible so far as the average tank house is concerned.

2—Rate Received and Sampled. This factor is often of primary importance in the treatment of high-grade pig copper, where every pig is drilled for sample. Obviously, the rate at which it may be used in the furnace is limited by the speed of the drilling. With blister not especially high in precious metals it is generally convenient to use the copper on the charge at a rate that will compensate for receipts, and thus save the expense of handling to storage and back to cars again.

3—Amount on Hand. When the receipts exceed the consumption there is an accumulation at the stockpiles. When the receipts fall off or the consumption increases, the amount of each brand designated for the anode charge is proportioned to accommodate the accumulation as well as receipts, in those instances where the equivalent silver so warrants.

4—Storage Facilities. It is often necessary to use a brand the equivalent silver of which would not justify its use at the time, simply because of lack of space in which to store receipts. It must go directly from the sample drills to the anode furnaces.

5—Availability. Occasionally a large quantity of low-grade copper is received and has to be stored in any available space. This may completely block off some higher-grade blister, which then cannot be used until sufficient of the low-grade material has been removed to free it again.

6—Physical Character. The shape, or the "top set," of the pigs may be such that they cannot be piled and transported except with the greatest care, and even then frequent spills may happen. In such circumstances only a certain amount of the blister can be used on the charge without excessive cost or delay in the charging—no matter what the amount of the equivalent silver may be.

Before calculating the charge, the operator must know the "furnace factor." By this term is meant a number which, multiplied by the total weight of any impurity going into the anode charge, will give as a product the weight of the impurity in the anodes cast from the charge. This factor may be calculated by carefully listing the weights of all items entering the furnaces for a period of, say, ten days. The amounts of the impurities are listed in columns, and the totals made, giving the weight of each impurity entering the charge. The average percentage of each is then calculated and compared with the corresponding figures actually found by analysis of the anodes produced from the charges for the same ten-day period. The actual percentage, divided by the calculated percentage, will give the factor desired. The following calculation is an example:

ANALYSIS OF CHARGE

Brand	Tons Charged	Contents of Charge, Pounds Lead	Nickel
A	150	1,650	1,575
B	250	1,650	2,150
C	25	900	570
D	500	250	675
E	100	8	116
F	125	25	35
G	125	23	75
H	600	96	504
Anode scrap	625	563	1,750
Totals	2,500	5,165	7,450

Average lead, 5,165 ÷ 5,000,000 = 0.103 per cent.
Average nickel, 7,450 ÷ 5,000,000 = 0.149 per cent.
Results actually found by analysis of the anode samples: Lead, 0.056 per cent.; nickel, 0.153 per cent.
Factor for lead, 0.056 ÷ 0.103 = 0.54.
Factor for nickel, 0.153 ÷ 0.149 = 1.03.

Factors for arsenic, antimony, and the other impurities are similarly calculated.

CALCULATING THE CHARGE

Suppose, on the first of the month, the stock sheet shows:

Brand	Tons on Hand, 1st	Expected to Arrive 1st to 10th	10th to 20th	20th to 1st
A	200	300	200	0
B	372	250	250	250
C	1,117	250	250	250
D	739	955	300	250
E	188	125	100	100
F	511	0	0	0
G	154	0	0	0
H	8,622	0	0	0
Totals...	11,903	1,880	1,100	850

The multiple tank house is operating at 7,000 tons per month. The anode furnaces will make one charge of 250 tons per day for the next ten days. This will mean 25 tons for each per cent of each kind of blister on the charge. The tank-house scrap, which may be assumed to average 25 per cent, must also be treated.

If impurities were all allowed to the maximum percentage, the following amounts could be present:

(1) Element	(2) Allowable	(3) Factor	(2) ÷ (3) Quotient	(4) Lb. per Ton	(4) × 7,000 Total Lb.
Lead	0.15%	0.54	0.28%	5.6	39,200
Nickel	0.155	1.03	0.15	3.0	21,000
Arsenic	0.15	0.92	0.163	3.3	23,100
Antimony	0.12	1.11	0.108	2.1	14,700
Selenium	0.10	0.93	0.107	2.14	14,980
Tellurium	0.05	0.63	0.079	1.5	10,500

Enter the anode scrap on the estimate sheet. With this taken care of, the operator is still allowed:

	Lb.		Lb.
Lead	37,625	Antimony	11,720
Nickel	16,100	Selenium	13,055
Arsenic	19,070	Tellurium	19,975

Considering the brands in the order of their equivalent silver:

"A." The important factor here is *Impurities.* Arsenic and selenium limit the amount to be used, and since there is an allowance of 6,500 lb. more of the former than the latter, the selenium governs. Each per cent of "A" on the charge is equivalent to 70 × 27 = 1,890 lb. of selenium. About 6 per cent, therefore, is all that can be used. With this amount on the charge, there is left an allowance of:

	Lb.		Lb.
Lead	33,005	Antimony	8,020
Nickel	11,690	Selenium	1,735
Arsenic	7,090	Tellurium	5,435

"B." Here again the important factor is *Impurities.* After an examination of the impurity table, it is apparent that arsenic will limit the use of this brand. Each per cent of "B" is equivalent to 70 × 7.4 = 518 lb. of arsenic. About 10 per cent of "B" can be taken care of with safety, leaving an allowance of:

	Lb.		Lb.
Lead	28,385	Antimony	4,800
Nickel	5,670	Selenium	1,315
Arsenic	1,910	Tellurium	5,323

"C." The controlling factors here are *Impurities* and *Availability.* On account of the excessive amount of impurities, this blister is given a preliminary furnace refining before being used on the anode charges. The operator has to consider only the skulls and other scrap resulting from the casting, amounting to about 1 per cent on the anode charge. This leaves an allowance of:

	Lb.		Lb.
Lead	25,865	Antimony	4,166
Nickel	4,074	Selenium	1,271
Arsenic	1,476	Tellurium	5,323

"D." The small remaining allowance of selenium will limit the use of "D." One per cent of "D" is equivalent

ESTIMATE SHEET, MULTIPLE ANODE COMPOSITION

For 30 days from.....

Brand	Per Cent	Tons	Gold Oz. per Ton	Gold Total	Silver Oz. per Ton	Silver Total	Lead Lb. per Ton	Lead Total	Nickel Lb. per Ton	Nickel Total	Arsenic Lb. per Ton	Arsenic Total	Antimony Lb. per Ton	Antimony Total	Selenium Lb. per Ton	Selenium Total	Tellurium Lb. per Ton	Tellurium Total
Scrap.....	25	1,750	0.87	1,520	100	175,000	0.9	1,575	2.8	4,900	2.3	4,030	1.7	2,980	1.1	1,925	0.3	525
A.....	6	420	4.5	1,890	630	265,000	11	4,620	10.5	4,410	28.5	11,980	8.8	3,700	27.0	11,320	10.8	4,540
B.....	10	700	0.8	560	400	280,000	6.6	4,620	8.6	6,020	7.4	5,180	4.6	3,220	0.6	420	0.16	112
C.....	1	70	1.0	70	150	10,500	36	2,520	22.8	1,596	6.2	434	9.2	634	0.64	45	nil	nil
D.....	25	1,750	0.65	1,140	67	117,000	0.5	875	1.35	2,360	0.05	87	0.14	245	0.4	700	0.14	245
E.....	6	420	0.98	411	55	23,100	0.08	33	1.16	440	0.02	8	0.04	17	0.7	294	nil	nil
G.....	6	420	0.85	357	2	840	0.18	76	0.6	252	0.2	84	0.26	109	0.6	252	0.24	101
H.....	21	1,470	0.15	220	13	19,100	0.16	235	0.84	1,230	0.4	588	1.1	1,617	0.14	206	nil	nil
Total...	100	7,000		6,168		890,540		14,554		21,258		22,391		12,522		15,162		5,523
Avg. oz. or lb. per ton.....				0.88		127.2		2.08		3.037		3.199		1.790		2.166		0.790
Per cent.....				.....		.....		0.104		0.152		0.160		0.089		0.108		0.039
Furnace factor.....				1.0		1.0		0.54		1.03		0.92		1.11		0.93		0.63
Estimated analysis, oz. per ton or %				0.88		127.2		0.056		0.157		0.147		0.099		0.100		0.025

to 70 × 0.4 = 28 lb. of selenium. About 25 per cent may be used, leaving an allowance of:

	Lb.		Lb.
Lead.....	24,990	Antimony.....	3,921
Nickel.....	1,714	Selenium.....	571
Arsenic.....	1,389	Tellurium.....	5,078

"E." This is a very pure blister, and ordinarily the *Rate Received* and the *Amount on Hand* would govern, but since there is such a small remaining allowance of selenium, the amount that it is possible to use will be limited to about 6 per cent, leaving an allowance of:

	Lb.		Lb.
Lead.....	24,957	Antimony.....	3,904
Nickel.....	1,224	Selenium.....	277
Arsenic.....	1,381	Tellurium.....	5,078

"F." *Availability* must govern the use of this blister —it is not available because the entire lot is surrounded by "H."

"G." The *Amount on Hand* is the ruling factor. Allowing 6 per cent to use up the entire lot in the next ten days leaves:

	Lb.		Lb.
Lead.....	24,881	Antimony.....	3,795
Nickel.....	972	Selenium.....	25
Arsenic.....	1,297	Tellurium.....	4,977

"H." This will complete the charge with 21 per cent. Under other conditions the *Physical Character* might be the limiting factor with this brand. The pieces have rounded bottoms and are, therefore, very hard to pile. The limit for the furnace ordinarily is about 40 per cent. Above this figure, its use will seriously delay the furnace working.

After the calculation is completed, instructions are sent to the foreman of the anode furnaces, giving the name and percentage of each blister for the anode charge and the estimated analysis of the resulting anodes. Copies of these memoranda are sent to the tank-house foreman, the yard foreman, and all others concerned.

The actual work involved in the calculation is not nearly so intricate as it may seem, when the necessary records and other information are kept up to date. Slide-rule calculations are permissible.

Experiments With Fume

At the Intermountain Station of the U. S. Bureau of Mines it has been found that a high temperature (1,000 deg. C.) is needed to form lead bullion from a fume (Yellow Pine ore) high in zinc oxide, although a fusible mass might be obtained at lower temperatures. It was also difficult, even after treating the fume with hydrochloric acid, to get a slag from which the lead collected well, although both metallic lead and slag were obtained at 800 deg. C. when using commercial slag-forming constituents.

Motion Pictures in Mining

The use of motion pictures is an important feature of the educational work of the U. S. Bureau of Mines in promoting safety and health among miners. The motion-picture films in the possession of the Bureau are also lent to individuals or organizations which intend to show them for educational purposes, especially for the promotion of safety, health, welfare, and efficiency in the mining industry. They are not permitted to be shown where an admission fee is charged. Transportation charges are borne by the borrower. This service has proved so popular that requests for the loan of some films can be filled only in the order in which they are received.

M. F. Leopold, of the Washington office of the Bureau, conducts the co-operative work with mining and other companies for the making of films of educational character bearing on the mining industry, and renders technical assistance in the planning of the work of making the pictures. He has also made arrangements with motion-picture companies so that the Bureau receives copies of motion pictures of events of special interest to the mining public.

Flotation Tests at Idaho Experiment Station

At the Moscow, Idaho, field office of the U. S. Bureau of Mines, where investigations relating to the theory of flotation are being conducted in co-operation with the University of Idaho and the Idaho Bureau of Mines and Geology, a special laboratory for the work on surface tension and adsorption has been provided. The following problems have been worked on:

1. Heat and emulsification.
2. Removal of oil in an emulsion by adsorption.
3. Equilibrium of adsorption and oil concentration.
4. Adsorptive capacity of minerals.
5. Treatment of emulsion of eucalyptus.

At the same office tests have been made on the use of sodium dibasic phosphate (Na_2HPO_4) as a differential flotation agent for lead-zinc ores at the Morning Mill of the Federal Mining & Smelting Co.

Iron Ore in Switzerland

It is generally little known that Switzerland possesses an iron ore mine. The mine is situated at the foot of the Gonzen Mountain in the Canton of St. Gall. Exploitation work was started in January, 1921, and the production has grown to about 100 tons per day. The ore is of a good medium quality. The mine is worked by a company which is capitalized at 3,500,000 francs.

BY THE WAY

A Fish Story from the Southwest

Duck-eating fish have been discovered. They swim in the Gulf of California and have been located by Col. John C. Greenway and Dr. L. D. Ricketts, who appear to have had as much success in angling as in mining. While on a fishing trip on the Mexican west coast, they caught a toratava, a sort of bass, this specimen being seven feet in length. After Dr. Ricketts had classified the fish, Col. Greenway found in its mouth a duck, evidently taken while floating on the briny. The party visited Tiburon island, but failed to come in contact with its notorious Seri Indian population. Harry Clark, superintendent of the Calumet & Arizona smelter at Douglas, also has been fishing, this at the Gulf terminal of the railroad proposed from Ajo. He tells that the new port is one of the greatest fishing points imaginable and speaks of capture of bass that weighed 180 pounds.

A Worthy Goal

Senator King recently said that the country would be benefited if the existing United States Senate were dismissed and each place filled with an engineer. Of course it would and it would mean ninety-six less engineers out of work in periods of depression. The idea is a good one and we shall make it our objective for 1922.

Holding at Arms' Length

"I been readin' a lot lately, m'son," said Cap'n Dick, "'bout 'ow h'over in the h'ol country they been makin' some o' these 'ere peers an' puttin' a 'andle in front o' their names. Be h'all right too, I guess, for some o' they that be worthy, but, dam-me, some be they 'oo are too 'igh an' mighty, an' it do turn their 'eads sumthin' h'awful. But, min' you, I don't say as 'ow this sort o' feelin' be peculiar to they chaps, for like as not it's boun' to 'appen mos' h'anyw'eres. I remember in tha h'early days w'en Cap'n Jan 'Oney was made district super, h'afer 'e 'ad been minin' cap'n for many years. Day or so h'afer 'e wuz promoted, one o' tha boys from town stopped 'im on tha street an' sez 'e, 'Cap'n, I congratulate you.' ''Ere, boy,' sez Cap'n Jan. 'Doan thee be cap'n me no more—I 'ires they chaps naow.'"

The Engineer Sans Culotte

The lure of chiclets has proved irresistible to H. T. R., of Nashwauk, Minn., so he rushes into print, to quote his own remarks, offering an explanation of the creation of Mrs. H. P. Whitney, as illustrated in the issue of Nov. 12 (page 777). He says:

"After several hours of 'crystal gazing' at that cut, some occult power guided me to the following conclusions: That Mrs. Whitney had the same conception of the engineer as did her famous contemporaries Ex-Secretary of War Baker, and General 'Black Jack' Pershing. Ancient history records how the boys flocked to engineering units destined for oversea service. How they pictured themselves with B. P. in hand, a broad-brimmed Stetson overhead, a transit or two in the background (for a close up of this, see most any correspondence school's ad.), and a gallery of French beauties in attendance. How they were rudely awakened from this dream upon being dumped knee-deep into mud and other mud, presented with a R.R. pick and the plebeian No. 2 and told to dig themselves and the Allied armies out. That probably accounts for the hump and agonized expression.

"The lack of shirt, etc., can only be explained on the grounds that this bird had indifferent luck playing strip poker. However, such are the vagaries of Lady Luck, that if Mrs. Whitney had happened along the next day for her inspiration she might have found him fully rigged in his buddy's regalia.

"I do not think Mrs. Whitney's choice of title a happy one, so would suggest that it be changed to 'Innocents Abroad,' with apologies to Mark Twain. Now if you have not consumed all the chiclets mail me one."

Many men many minds. Charles Hendricks, of Gold Bar, Wash., says that he would call the creation "A Stoker," and that if the sculptress will visit a boiler room on some of the large steamships and see a stoker in action she will agree with him.

Samuel H. Dolbear is less inclined to be critical of things in general, now that his war minerals relief claim is settled. He says:

"The statue is undoubtedly a recent creation, and such engineers who have been fortunate enough to have jobs during the past year have been doing that kind of work. The absence of clothing is due to the fact that the picture was taken prior to pay day. Had Mrs. Whitney waited until after the tenth of the month, her artistry would have been more difficult, for this chap would likely blossom out in a tuxedo. His credit would at any rate have been good for a pair of Can't-Bust-Ems at the company store."

A resident of Silverbell, Ariz., who says he is more anxious to nibble the chiclets than he is to appear in print as an art critic, is nevertheless moved to discuss the subject to the extent of 500 words or so, more than there is space for here. The figure, he says, represents modern woman's idea of the Missing Link. It is probably intended to depict man at a period shortly after the process of evolution had begun to change him from a horizontal quadruped to a vertical biped, and in the act of making his first attempt to stand erect. The hat is an anachronism, of course.

A surprising thing brought out by this nation-wide and even international discussion is that no two individuals have interpreted the statue alike. P. D. Q. thinks it fittingly pictures the mucker who first suggested that mining engineers be licensed.

Calamity Cañon

BY PAUL H. KEATING

Written for *Engineering and Mining Journal*

There's a place in Colorado that is very little known; its a God-forgotten region in a way. The electric lights are missing with the bath and telephone, and it's not a place where one would care to stay. It's so far from town or city that they get mail-order wives, and the wops and college men are like two peas. There are fugitives and roughnecks who have played with guns and knives, and are hiding from the law and lawyer's fees.

It's so far from habitation and so quiet that you feel (in the evening when its growing cold and dark), you could serve a year in Hades and be glad to make the deal, just to hear a lonesome coyote howl or bark. It's a place where laws and outlaws are on friendly terms at last, and your past is dead and buried. Never tell of the days you wore a dress suit and you lived both high and fast, or of counting off the minutes in a cell.

I have lived in better places and in places that are worse; I can be contented there with half a try. And for all its seeming drawbacks it's the only place on earth where the eagle on a dollar doesn't fly.

CONSULTATION

Centrifugal vs. Reciprocating Pumps

With the thought that his experiences with various types of pumps may be of interest to readers of *Engineering and Mining Journal*, Mr. Edward T. Keenan, mechanical superintendent of the American Cyanamid Co. at Brewster, Fla., has contributed the following remarks on selecting the proper pump:

"With reference to 'Centrifugal vs. Reciprocating Pumps,' under the head of 'Consultation,' in your issue of Jan. 14, perhaps my experience with pumps may be of value to the party asking for the information. As you state, your correspondent fails to explain the cause of the failure of the centrifugal pump. However, he may feel at liberty to communicate with me if he desires.

"I have had experience with reciprocating and centrifugal pumps, both pressure and mining, and in the hydraulic mining industry. I appreciate the service demanded of a pump. It has been my experience that the manufacturer's recommendations are not always of sufficient accuracy to enable one to select and purchase the proper pump for the service demanded. In relying upon the manufacturers one must be governed by the fact that the manufacturing company has a standard line of pumps, and unless the company is specifically charged with quoting on a certain pump, it confines its quotations to its standard line. So a purchaser, as a rule, should not order a pump of any description without consulting a proper authority. This I learned by experience. I will endeavor to explain why, in a few words.

"Taking centrifugal pumps for example, inasmuch as the correspondent stated he had had unsatisfactory results with this type of pump, I will venture to say there are few operations, if any, where a properly selected centrifugal pump, properly installed, will fail to give satisfaction.

"It is comparatively simple to determine the simpler features demanded and required in a centrifugal pump, such as the number of stages, method of drive, and the rotative speed. Almost any manufacturer's recommendations may be accepted, but the matter of vane angles, the number of vanes, balancing device, composition of the impeller, ratio of the width of the impeller to its diameter, and the peripheral speed of the impeller, are salient features that should be predetermined and specified, to the manufacturer.

"It would be decidedly improper to select a pump with a rising characteristic, when a flat characteristic is demanded; that is, if the head against which the pump is obliged to work is subject to variation, the characteristic should be such that the electric motor (if the pump is driven by a motor) will not be damaged by overload, due to too low a head and an increase in capacity. Again, perhaps the motor is of sufficient size to permit of a considerable increase in load without damage, which may be taken advantage of in the design of the pump. At any rate, the area of the highest efficiency of the pump should extend over the range of variable head as completely as possible.

"Again, the quantity of water which the pump is to deliver may be variable and the head may remain nearly constant. In this circumstance, the characteristic should be such that the point of highest efficiency should cover the range of capacity, as nearly as possible. In any event, the point of highest efficiency of both pump and prime mover should occur together.

"As to the matter of balancing, both mechanical and hydraulic balancing devices are made which give good results in practice. However, there are instances where neither one alone should be relied upon, and in selecting a pump with a hydraulic balancing device, care must be taken to choose one in which gritty water will have the least effect."

Uses of Finely Ground Silica

"In your columns of current price quotations for various minerals, I note that a recent quotation for fine silica between 250 and 500 mesh is given as $16 to $30 per ton, considerably more than silica is worth in any other form. I should be greatly interested to know of the purposes for which this fine silica is used."

Silica (SiO_2), finely ground and referred to in our market reports, is extensively used as a paint pigment. In the Middle West tripoli, the siliceous residue of decomposed limestone, is used to produce an excellent grade of ground silica, which is utilized for the same purpose as the other varieties obtained by grinding massive crystalline quartz or sand and sandstones. One producer informs us that his product, the amorphous or decomposed variety, will analyze 99½ per cent silica and contains only slight traces of iron and alumina. As it is inert, has no tinting properties, and is not affected by any vehicle used for paint manufacture, it is an ideal pigment. It also has absorbing powers that make it suitable for that purpose. This variety can be pulverized to impalpable fineness, but the average grades run from 250 to 400 mesh, the standard meshes most used being 250 and 350. Ninety-eight per cent of the silica passes through 250 or 350 mesh screens in order to be classed as extremely fine material. Wood-fillers commonly contain fine silica, for which use it is excellently adapted.

Silica is also used in the manufacture of scouring soaps, as polishers, in pottery manufacture and in chemical processes. It must be exceptionally pure for use in the pottery trade, and should contain less than 0.5 per cent of impurities such as iron-bearing minerals. Silica gives a glaze and is employed in the body of the ware to decrease shrinkage.

When used in paint manufacture, it is desirable that the silica grains should have pronounced angularity to make them adhere more firmly to the surface coated. The same characteristic is desirable in wood-fillers and polishes. Varying proportions of silica are used in paints but may run as high as one-third of the total pigment used. Some dental preparations also contain fine silica.

No Gold-Locating Instruments Developed

"Can you advise me where to obtain an apparatus or how to make one for the location of buried gold? I have a chart giving location of two places and am just crazy enough to try, provided I can get the necessary instrument. My chart is thirty years old."

There does not exist, so far as we know, any instrument that will locate buried gold. We certainly advise you not to give the matter any further thought. All kinds of extravagant claims, hoaxes, and swindles concerning reported wonderful ore-finding instruments have been made. Scientific experimentation now going on may gradually enable a certain detection of underground conditions, but nothing has yet come to our attention that is worthy of your experimentation or even of serious consideration.

HANDY KNOWLEDGE

Uses of Compressed Air in Mining

BY W. R. WADE

Written for *Engineering and Mining Journal*

The air lift as an auxiliary aid in mine pumping is not as generally applied as it should be. An experimental lift was installed in a mine at Edwards, N. Y., to be used in case of the failure of one of the pumps. This mine makes a large flow of water. Pumping is done in stages by electrically driven centrifugal pumps. The water does not all come from the lowest levels, but much of it originates several hundred feet above the lowest workings. Before the installation a drift on the 700 level was making 200 gal. per minute, which was carried down the shaft to the 840 level to the nearest pumping station. By a system of valves it was arranged to discharge this water either into the sump or to pump it to the next relay station above with compressed air. For the discharge column one of the pump columns was used. Fig. 1 shows the arrangement. This handled all the water from the 700 level. It was only about four days after the installation that one of the centrifugal pumps had to be shut down for repairs. The other pump with the assistance of the lift was able to handle the water. As 540 gal. per minute is handled at this station, one 300-gal. pump alone cannot do the work, and two pumps running practically all the time are required. As a standby the air lift takes the place of a third pump. A centrifugal of the type used costs $4,000 installed. As there is ample compressor capacity the lift saves this investment. A recent test showed the centrifugals to have an over-all efficiency of 48 per cent. This included transformer losses, transmission losses, motor losses, and pump and pipe friction losses. The efficiency was the water horsepower against the electric power paid for. Calculated on the same basis—that is, considering the electric power purchased to drive the compressors—this lift shows 31 per cent efficiency.

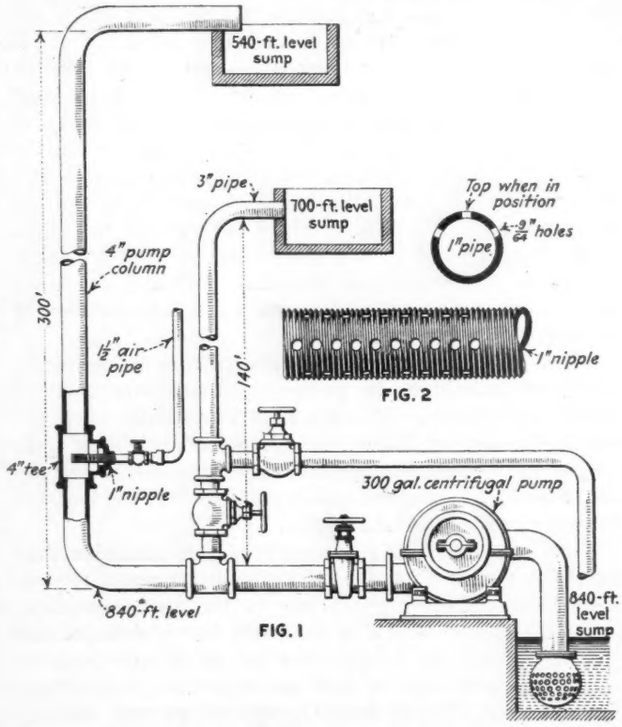


FIG. 1. SHOWING AIR LIFT AS AUXILIARY TO PUMPING SYSTEM. FIG. 2. PERFORATED NIPPLE

The air is admitted into the pump column through a 1-in. nipple with 4 in. of thread cut on it. This permits the nipple to be screwed nearly to the back side of the tee. The end of the nipple is plugged and its top surface is bored with 9/64-in. holes, in three rows. Fig. 2 makes this clear. The water is brought down from the 700 level in a 3-in. pipe. This gives 140 ft. for the submergence. The delivery column is 4 in. and the air is introduced at the 840 level, as shown in Fig. 1.

The specific gravity of the water and air mixture in column *B* in Fig. 3 is lower than that in column *A*, which is plain water. The weight of the water in column *A* is greater than the weight in column *B*. Therefore the water in *A* forces the aerated water in *B* upward until the weights of the two columns balance. If the discharge of *B* is below this point the water will flow. The higher the lift in relation to the submergence, the more air demanded. To illustrate, suppose *A* is 50 ft. and *B* is 150 ft. Then if the mixture in *B* is one-third water and two-thirds air it will have to rise to the top of *B* to balance the clear water in A. If *B* is 200 ft., the mixture will have to be one-fourth water and three-fourths air. In practice, as the mixture is never perfect and as a strong flow is desired, it takes considerably more air than the theoretical amount.

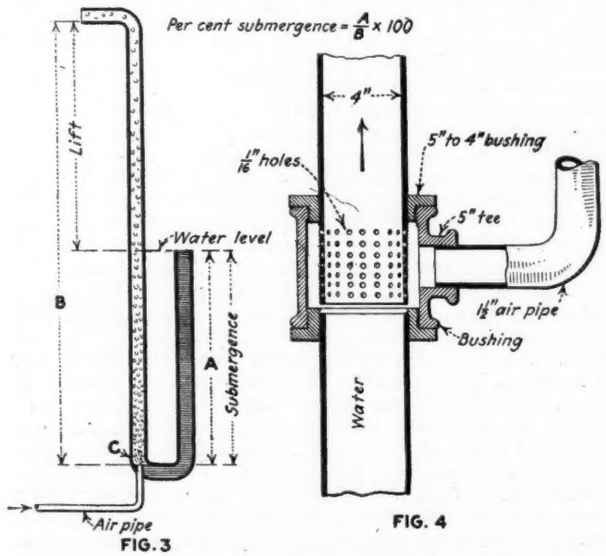


FIG. 3. DIAGRAM ILLUSTRATING AIR LIFT PRINCIPLE. FIG. 4. FOOT PIECE FOR AIR LIFT MADE OF PIPE FITTINGS AND GIVING GOOD RESULTS

I would like to call attention to the percentage of submergence. This is used in all tables on air lifts. It is the length of pipe *A* divided by *B* times 100. The air pressure must be greater than the hydrostatic pressure at point *C* or no air will flow into the lift. The hydrostatic pressure is that caused by the water in column *A*. It will be .434 lb. per ft. of submergence. As mine compressors are generally limited to 100 lb. the practical limit of submergence in mining is 200 ft. This requires 87 lb. at their air nozzle, and the pressure should be at least 2 lb. more to allow for friction at this point. Many writers on air lifts state that they will not work on less than 33 per cent submergence. As 66 per cent is recommended for low lifts and 41 per cent for lifts around 500 ft., it would not appear possible to get the necessary submergence around a mine. S. F. Shaw at the Tiro General mine[1] operated a lift with only 1.8 per cent submergence, raising the water 1,000 ft. The submergence was 18 ft. The claim is not made here that such low submergences are efficient but that they will pump water if the lift is properly designed. I have operated lifts pumping only to moderate heights with less than 10 per cent submergence.

The accompanying table will be found convenient in figuring on air lifts around the mine. It is based on an air consumption of four times the theoretical amount.

FREE AIR CONSUMED PER GALLON OF WATER DELIVERED ASSUMING 25 PER CENT EFFICIENCY

Feet of Lift	Submergence in Feet			
	50 ft.	100 ft.	150 ft.	200 ft.
50	0.84	0.52	0.48	0.40
100	1.72	1.08	0.92	0.80
150	2.60	1.60	1.41	1.20
200	3.44	2.12	1.88	1.62
250	4.36	2.68	2.36	2.08
300	5.20	3.20	2.80	2.44
350	6.08	3.72	3.28	2.84
400	6.88	4.28	3.76	3.21

Theoretical air required would be one-quarter the number of cubic feet shown in this table.

APPROXIMATE STAND PIPE CAPACITY-GALLONS PER MINUTE AT 200 FEET SUBMERGENCE

Feet of Lift	Size of Pipe in Inches				
	3	4	5	6	8
50	175	350	500	750	1,200
100	125	275	400	650	1,150
200	50	225	325	550	1,100
300	20	150	275	450	1,000
400	...	50	200	350	900

Less submergence gives less capacity.

This is a low efficiency, but for crude lifts is about right. Anyway it is on the safe side. The figures given for the different depths of submergence represent the quantity of free air consumed per gallon of water delivered, assuming 25 per cent efficiency. Calculations were made from S. F. Shaw's formula

$$X = \left(\frac{L}{255 \text{ Log } \frac{S + 34}{34}} \right) \times \frac{25}{100}.$$

In Fig. 5 is shown a simple method of unwatering a winze. The water can be lowered to within a few feet of the bottom. The final wind-up will require a pump and the air lift water column will make the pump column. In the meantime the water has been lowered most of the way without any of the bother of repeatedly lowering a sinking pump.

Recently it became necessary to pump water with a pump that would not lift it as high as required. The job was accomplished with complete satisfaction by turning live air into the water column where it left the pump. As the column full of water set up a greater pressure than the air pressure it was necessary to turn the air on before starting the pump. The pump then acted as a submergence for the air lift.

The exhaust from direct-acting air pumps comes out with considerable force, and this energy can be utilized by piping it into the pump column. It also prevents freezing at the exhaust. The pump will elevate the water slightly higher than it will with the exhaust discharged in the open, as is generally practiced. A check valve must be placed between the pump and the water column to prevent the water working back into the air cylinder. Also a by-pass should be provided to the open, for use in starting the pump. The exhaust should be turned into the column as soon as the pump gets under way. Once the exhaust air gets started in the column it ascends with the water, making the column lighter. This exhaust air acts as an air lift, while the pump furnishes the submergence. As the exhaust air is colder than the water when it first enters the column, this air absorbs heat from the water, which in turn expands the air, so that some energy is obtained from the water itself. It is our practice to pipe all air-pump exhausts into their water columns. We have air pumps raising water 300 ft. vertically, operating on 80-lb. air pressure at the pump, which discharge their air directly into the pump column. When not so discharging, these pumps give constant trouble with freezing, and though we have no definite figures, they seem to consume considerably more air for the same water delivery. The water column should always be large enough to handle the mixture of air and water. If it is ½ in. larger than the proper column for the pump with open exhaust, it will be satisfactory. In fact, we have had pumps working this way where the column was really smaller than it should be for just the plain water. However, this is very inefficient and should be avoided. Fig. 6 shows the proper arrangement.

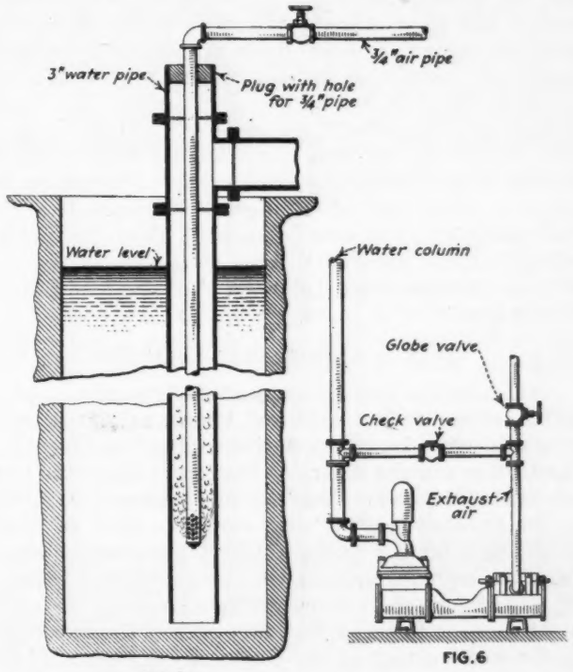


FIG. 5. METHOD OF UNWATERING WINZE. FIG. 6. SHOWING PUMP DISCHARGING EXHAUST AIR INTO WATER COLUMN

[1] "Unwatering the Tiro General Mine by Air Lift," S. F. Shaw. *Trans.* A.I.M.E., 1920.

THE PETROLEUM INDUSTRY

The White Point Gas Field

BY ALBERT G. WOLF
Written for *Engineering and Mining Journal*

THE RECENT DEVELOPMENT of the old Mexia gas field into one of the largest producing oil fields of Texas lends new interest to other old gas fields of this state in which sufficient drilling has not been done definitely to prove their mineral content. The White Point gas field comes under this classification, and the following article is presented not as a geological report but as a general description that may be of interest to many who are unacquainted with this little-known but promising field.

White Point is in San Patricio County, Tex., about six miles northeast of Corpus Christi and on the opposite side of Nueces Bay. As its name implies, it is a tongue of land projecting into the bay. Around the bay shore is a low, gently sloping belt, some of it a tidal flat, and back of this belt is a bluff 40 or 50 ft. high, which extends around the bay itself and on south of Corpus Christi. Back from the bluff the land is practically level.

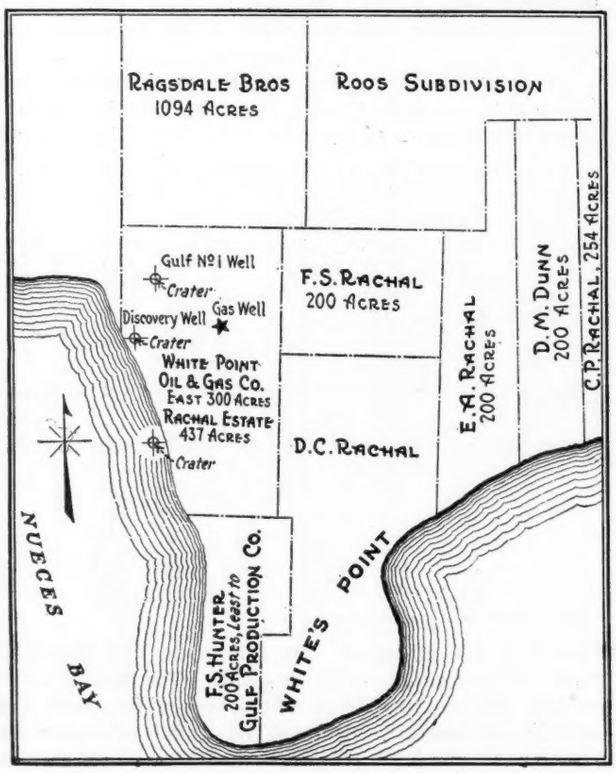
LIMESTONE PROMINENT FORMATION

The surface is covered everywhere by sand or a black, heavy, sticky (when wet) soil known as "black land." The most conspicuous formation exposed on the face of the bluff is a white limestone that outcrops on the western side of the point. This is a fine-grained rock similar to the so-called "calichi" that covers so much of Southwest Texas farther to the west. A large percentage of this rock is soluble in acid, leaving a residue of rounded, white silica grains. Some geologists consider the rock a phase of the Reynosa, the lower beds of the Pleistocene in the western part of the Gulf Coastal Plain. If this be true, the upper beds of the Pleistocene, unlike the entire Texas coast northward from this section, are almost entirely absent as the limestone crops near the top of the bluff, and its apparent dip is not great.

No opportunity to examine samples from wells drilled in this field has presented itself, but it is probably reasonable to assume that the entire series of strata passed through in drilling belong to the Pleistocene and upper Tertiary. The log of one well drilled to a depth of 1,910 ft. shows ninety-eight changes of formation in that depth, including two gas-bearing strata. Most of the beds were gumbo, shale, sand, and rock, with sandy variations of gumbo and shale, and the rock strata, in most formations, were quite thin. This compares with most of the other wells of this depth in the Gulf Coast region.

Claims have been made that White Point is a salt dome, but they are entirely without foundation in fact. To date no formations proving the existence of a salt dome, such as a rock-salt core or the overlying cap rock of anhydrite and porous crystalline limestone, have been found. It is true that salt water and saline water charged with hydrogen sulphide occur here, but these are found in areas other than salt-dome oil fields and prove nothing. It is my belief that the structure of this field is an anticline. This opinion has been previously expressed by Alexander Deussen.[1]

Drilling at White Point began in 1914. It was induced by the discovery of a gas seep on the west side of the present field. The discovery well, No. 2 of the White Point Oil & Gas Co., came in suddenly on Nov. 11, 1914, as a tremendous gasser at a depth of 2,260 ft. The casing was blown from the hole, the derrick dashed



SKETCH MAP OF WHITE POINT GAS FIELD, TEXAS

to pieces, and the top of the well soon became a yawning crater in which the drilling rig was swallowed. The collection of mud and water in the crater eventually plugged the well, but not until a great loss of gas had occurred. The gas flow was roughly estimated to be 50,000,000 cu.ft. per day. The crater is now about 200 ft. in diameter, with nearly vertical walls 50 ft. deep to the level of the water that has collected in it. Some gas is still bubbling up through this water.

Later the Gulf Production Co. obtained a lease on this ground and drilled a well about 800 ft. north of the discovery well. This work was begun in September, 1915, and in December the gas sand was struck at

[1] "Review of Developments in the Gulf Coast Country in 1917," by Alexander Deussen, Bulletin of the American Association of Petroleum Geologists, Vol. 2, 1918, pp. 35-36.

2,200 ft. Eight-inch casing was set, extra heavy fittings were attached, and several tons of cement poured around the connections. Bailing was then started, but the mud was lowered only part way when the well came in with such force as to blow the derrick to pieces. During the first week in January, 1916, the well was capped.

To quote from an account of this well published in the *Fuel Oil Journal* (the forerunner of the *Oil Trade Journal*) of February, 1916: "The massive fittings, weighted down with tons of cement, held until Wednesday, Jan. 12, when, under the constant pressure, they gave way, stripping the threads from the irons buckled into the cement and throwing off the gate-valve connections. The hole soon began spouting sand, mud, and water along with the gas. The friction of the solid particles cut through the casing, part of which was lifted out of the hole, the remainder dropping out of sight."

As a matter of fact, everything about the rig, including the boiler, was lost in the crater of this well. Sand fell in the streets of Corpus Christi, six miles away, and later, when the gas became ignited, flames leaped over 200 ft. into the air. The flow from the well was estimated to have been in excess of 100,000,000 cu.ft. daily, and the pressure, from experiments with a pitot tube,

HOLE MADE BY BLOWING GAS FROM WELL

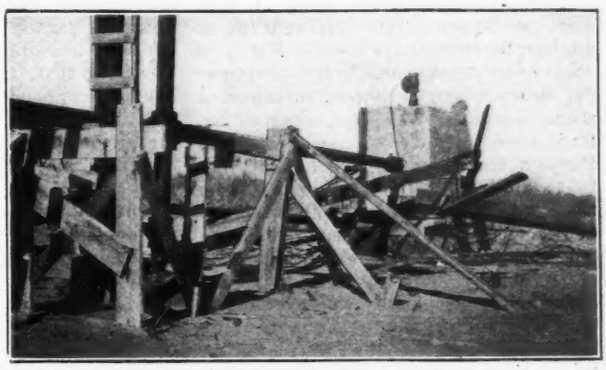
to be 1,100 lb. This well, like the discovery well, eventually became sealed off, and only a little gas is now escaping from the well, visible where it bubbles up through the water in the bottom of the crater. This crater is between 300 and 400 ft. across and 75 to 100 ft. down to the water.

Other wells were drilled in which gas-bearing strata were found at 450 ft., 1,900 ft., 2,260 ft., and 3,400 ft. The Gulf Production Co.'s No. 5 well was abandoned at 4,500 ft. after passing through the gas sands at 2,200 and 3,500 ft. No oil was encountered in this well. A strong flow of hot salt water was struck at 3,600 ft., and this water is being used in an improvised bath house. Another well, on the bay shore, also blew a considerable crater at the surface, but left the casing. This casing has evidently collapsed, and a flow of salt water highly charged with hydrogen sulphide is still issuing from the casing.

Finally a third big well was drilled to the 2,200-ft. gas stratum, in which the casing held. After blowing wild for a couple of years, and wasting billions of cubic feet of natural gas, this well was ordered closed in by the Oil and Gas Division of the Railway Commission.

A cross connection was placed on top the casing, and a valve on each of the three arms. Then a concrete monolith was built around the casing, completely surrounding the valves. The block is about 6 ft. square above ground, 8 ft. square below the surface, and 20 or 30 ft. deep. Pipes leading to the valve stems are cemented in so that the valves can be turned by long wrenches. Other valves were placed on the pipes outside the cement. A horizontal blow-off pipe was laid from the well, and the force of the blowing gas alone was sufficient to dig a large hole in the ground.

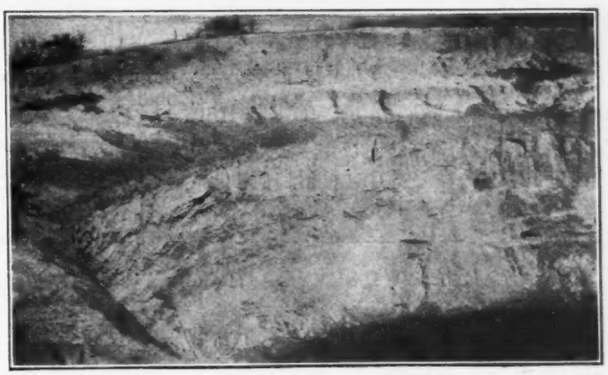
For some time this well has been supplying gas for all the industries and dwelling houses at Taft. Only recently the meter on this well showed a pressure of



CONCRETE ANCHOR USED TO CLOSE GAS WELL

520 lb., even with the supply going to Taft and with a considerable escape from the blow-off pipe from the water separators. If the well were closed in the pressure would go up to 700 lb. per sq.in. The gas is free from sulphur and tests about 900 B.t.u. It is almost dry, but a little light, slightly pinkish tinted oil collects in the valves at the well.

In September, 1921, an association of capitalists of north Texas, headed by S. J. Campbell and L. D. Prewitt, of Dallas, and called the Campbell-Prewitt interests, secured a lease on 1,480 acres from the White Point



CRATER OF NO. 2 WELL OF WHITE POINT OIL & GAS CO.

Oil & Gas Co., agreeing to drill within a certain time limit. These interests also secured a franchise from the city of Corpus Christi to supply natural gas within its limits. This project will necessitate the construction of a pipe line across Nueces Bay. The White Point Oil & Gas Co. will receive a royalty based on cubic footage of gas at the wells. Further drilling in this field, to be undertaken soon, will be watched with great interest, not only because of the almost certainty of developing a large supply of natural gas, but because of the possibility of opening a new oil field in an unproductive portion of the Texas Gulf Coast.

Book Reviews

Must the Critique Always Be Favorable?

WE WERE SOMEWHAT AMUSED to read in a local newspaper the other day that a Cuban journalist fought a duel with an outraged author over an unfavorable book review. The book in question described conditions in Mexico, which did not make the duel quite so inappropriate an event as it might otherwise have been. Fancy a duel over "Pollyanna," for instance. Sr. Ossorio, the reviewer, sustained a slight wound, it was said, whereas Sr. Ballesteros received a sword thrust through the shoulder which sent him to the hospital. Let this be a lesson to the authors of books: they should not become unduly exercised over criticism. So far, we have escaped and we hope that we shall continue to do so. One of the reasons why we never really hankered for a training in a German technical school was that we feared we might have to fight a duel, for we preferred to retain both of our ears and not have a place where we had to be careful in shaving.

Seriously speaking, this brings up the question of unfavorable criticism. One well-known technical editor in this country tells us that it is a rule in his office to avoid reviewing books about which he cannot speak in a friendly way; that is, a book will not be reviewed unless he can speak of it favorably and helpfully. We do not agree with this point of view. If the title and prospectus of a book is likely to attract our readers, we feel that they are entitled to know our honest opinion of it. We try to give an idea of what the book contains, of its good and bad points as we see them. If a book is a poor one in our estimation we say so, whether it is published by McGraw-Hill or someone else. Of course, the opinion is only ours, and higher authorities may disagree, but this is about all that can reasonably be expected of us.

IN AN EARLY ISSUE we hope to review "Within the Atom," by John Mills. This is said to "admit the non-scientific reader to the mysteries which science is penetrating." Of course, we, being scientific men, will find nothing that we do not already know, but it may be a good book to buy for our sweethearts or wives.

A Manual of Flotation Processes. By Arthur F. Taggart. Cloth; 6 x 9; pp. 181. John Wiley & Sons, Inc., New York; 1921. Price, $3.

A book on flotation in the index of which no such words as "litigation," "patents," "royalties," and "history" can be found is somewhat of a novelty, and we think will be a welcome one to the average flotation operator. No conflicting theories are offered to puzzle the reader. In the first chapter, of twenty-two pages, the author states clearly and concisely his own opinions, based on experience and experimental research, as to why and how flotation works, and the governing conditions, from the practical standpoint. Then come about seventy-five pages on testing equipment and methods; forty pages descriptive of the leading makes of commercial flotation machines; and thirty pages devoted to the flow sheets, and reasons therefor, at representative flotation plants. A large number of detailed drawings and charts supplement the text. Several valuable tables are also appended.

Mr. Taggart is professor of ore dressing at Columbia University. Under his direction, in 1919 and 1920, research work was carried on which indicated an essential difference in principle between the operation of machines in which the froth is caused by violent agitation and those in which the froth is made by the admission of air at or near the bottom of the cell, as in the so-called pneumatic machines. In those machines which depend on beating the pulp into a froth (the Minerals Separation and the Janney, for example) Professor Taggart believes the phenomena to be as follows: The rapidly moving impellers throw the pulp to the periphery of the agitation chamber, thereby depressing the surface at the center and creating a vortex. When the vortical cone above the pulp level reaches the impellers, air is entrained and is immediately broken up into many small bubbles. As the pressure in front of the rapidly moving blades is considerably greater than at other points, a portion of these small bubbles passes into solution. Away from the impellers, however, the pressure is normal, and behind the impellers, subnormal, so that the pulp, except directly in front of the blades, becomes supersaturated with air. Bubbles of air therefore re-form, and do so on the oiled sulphide particles present in the pulp. The bubbles of air rising through the pulp in this type of machine have been found to be coated with sulphide particles—the concentration having been made in the body of the pulp as the bubbles form. Professor Taggart therefore calls the process "pulp-body concentration," which would seem to be a fitting term.

In distinction to the phenomena already outlined is the "bubble-column process," in which the bubbles are larger and more numerous than in the pulp-body process and therefore rise through the pulp more rapidly. They have been found to carry sulphide and gangue particles in the same ratio as they are found in the pulp through which they pass, no concentration taking place until the level of the pulp (the bottom of the bubble column) is reached. But in the layer of bubbles at the surface of the pulp, study shows that "there is a differential draining of the gangue and sulphide particles; that the average downward velocity of the sulphide particles is less than the average upward velocity of the bubbles; that the average downward velocity of the gangue is greater than the average upward velocity of the bubbles; and that, as a result, the sulphides are lifted up and away from the gangue. It is apparent, also, from such study, that the sulphide particles in the bubble column are nowhere firmly adherent to bubbles, as they are in the pulp-body processes."

Besides the Callow cell, bubble-column concentration is said to take place in the Ruth, Groch, Hebbard, Rork, and K. & K. machines. One would think the last two mentioned would not come in this class, but Professor Taggart has found that the "pulp is displaced so rapidly through the zone of the moving parts into the quiet zone, that the time is insufficient to effect pulp-body concentration."

Not being familiar with the experimental work upon which Professor Taggart's assertions are based, we are not qualified to offer intelligent comment thereon. A full explanation and discussion is promised in a later book; until this is published we can only admit the reasonableness of the author's views, at the same time rather holding aloof from the idea that there is in all instances a sharp dividing line between the two processes. It is interesting to observe that Professor Taggart believes that any ore amenable to froth flotation can be treated with equally good metallurgical results by either process.

The theory of supersaturation in the agitation compartment, on which Professor Taggart's views are based, seems to have been advanced privately as early as 1907 by Sulman and Picard, but to have been carefully avoided in Sulman's paper published by the Institution of Mining and Metallurgy in 1919. This may have been done advisedly, for, as we all know, flotation is a legal as well as a metallurgical process. We expect that Professor Taggart's work will have a wide airing in the courts.

Certainly the first chapter of this book is the most interesting, but the remainder is no less valuable to the flotation test man and operator. The author does not hesitate to state his opinions of procedure, processes, and machines, and with his ideas we generally agree. He devotes a page to a comparison of flotation machines which we think might well have been amplified, giving more of the details as to why some types of machines have been thrown out of certain plants. Mr. Callow and others of his school should feel encouraged by the prophecy that "ten years' time will see the agitation-type machine almost completely displaced by machines of the pneumatic type."

This small volume is well written, well edited, and well printed, and on the subjects which it covers we consider it easily the best book available today.

E. H. R.

ECHOES FROM THE FRATERNITY

SOCIETIES, ADDRESSES, AND REPORTS

New York Section, A. I. M. E., Opposes Licensing of Engineers

Among a majority of those present at the meeting of the New York Section of the American Institute of Mining and Metallurgical Engineers, held at the Machinery Club, on Jan. 11, the bill for the compulsory licensing of engineers seemed to be as popular as a bow-legged girl in her own home town. The subject of the evening was open for discussion immediately following the usual dinner. W. Y. Westervelt, as chairman, introduced P. E. Barbour, assistant secretary of the Institute, and also vice-chairman of the present Engineers' Licensing Board of New York State. Mr. Barbour outlined the history and purport of the Engineers' Licensing Bill, which passed the Legislature, was signed by the Governor, and becomes compulsory in May, 1923. Mr. Barbour refrained from any comment either for or against licensing, but simply stated conditions as actually specified by the measure.

B. B. Gottsberger, the next speaker, gave a résumé of the legislation with regard to the licensing of engineers, now in effect in nineteen states. He stated that, in his opinion, there was considerable opportunity for study, as engineers in general, and particularly mining engineers, did not feel that there was justification for such measures. A serious objection to such laws was that the effect would be not to rule out the unfit, but that there was a danger that engineers would be forbidden to develop. The arguments thus far given by the supporters of the licensing bill are without real justification, particularly as applied to mining engineers.

W. R. Ingalls, in a letter to the chairman, stated he believed that all efforts should be made to check and repeal the movement and also said that one great difficulty lay in the fact that no satisfactory definition of engineers had yet been reached. This opinion was also held by a number of those present.

J. M. Goodell, the next speaker, said that civil engineers had had licensing thrust on them, and he outlined the early work which had been done in furthering the licensing movement. He believed that the civil engineers, as well as others, should help to administer the laws as they now exist until they can find out the general effect, and make such corrections as seem necessary.

D. M. Liddell, in a letter to the chairman, stated that engineers were not to be considered in a class with doctors and lawyers, as their practice was often not a local one, but covered professional work in numerous states, and that the securing of licenses in every state would work an unnecessary hardship on them. F. T. Rubidge told of the work done by the licensing committee appointed by Engineering Council in 1918, of which he was a member. This committee spent considerable time investigating, and attempted to secure as many opinions as possible. At the time the report was made, there had been no opportunity for extensive expression of opinion.

R. A. Parker, chairman of the Colorado Section, stated in a letter that the licensing bill as passed in Colorado was an underhanded piece of legislation, and one with which none of the mining engineers were in sympathy or expected to receive benefit from. Col. A. S. Dwight outlined the more recent work of Engineering Council with respect to engineer licensing. He said that the committee had done all that it could do and that there still existed a radical division of opinion.

Allen H. Rogers then proposed a resolution, but at this point D. M. Oltarsh, one of the originators of the Engineers' Licensing Bill in New York State, attempted to explain the measure. His attempts were more antagonistic than explanatory, and resulted in considerable discussion on the floor. The resolution, which was seconded and passed with but one dissenting vote, is as follows:

"Whereas the legislature of this state has passed a law requiring that engineers be licensed for the practice of their profession; and,

Whereas it is our belief that this law or any other law for the licensing of engineers does nothing to improve the status of the engineer and is not required for the protection of the public; and,

Whereas this law imposes an unjust and burdensome restriction on engineers in the practice of their profession;

Resolved, That the members of the New York Section of the American Institute of Mining and Metallurgical Engineers present in meeting assembled pledge themselves jointly and severally to work for the repeal of this law and to oppose any similar legislation; and

Resolved, That a copy of these resolutions be transmitted to the Board of Directors of the A.I.M.E., with the request that the appointment of a committee of five by the chairman of the section be approved, said committee to plan and carry out measures for the repeal of the New York licensing law, and to this end authorized to receive and disburse funds and to co-operate with other engineering organizations."

An attempt on the part of Mr. Oltarsh to have the resolution held over until a later meeting was stopped for lack of a second. Directly preceding the closing of the meeting, Dr. H. M. Payne stated that he regarded the entire engineering license movement as selfish legislation, and considered that it had been fostered by labor-union propaganda and agitation, pure and simple.

Mine Law Revision Opposed in Colorado

The annual meeting of the Colorado Metal Mining Association and the Colorado Chapter of the American Mining Congress met in joint session at Denver on Jan. 16 and 17. Operators from the principal mining camps reported a revival of mining interest throughout the various districts. Several of the large operators stated that they were preparing for enlarged operations and a considerable number of new mining enterprises were announced by members present.

George A. Stahl, general manager of the Vindicator Consolidated Gold Mining Co., at Cripple Creek, was elected president of the Colorado Metal Mining Association, and George E. Collins, of Denver, was elected governor of the Colorado chapter of the American Mining Congress. M. B. Tomblin was elected secretary of both organizations and A. M. Collins, treasurer.

The meeting went on record as opposed to the revision of Federal mining laws as proposed in H. R. 7736, and a resolution was adopted favoring the transfer of the Forestry Department from the Agricultural to the Interior Department.

University of Illinois Offers Research Assistantships

To assist in the conduct of engineering research and to extend and strengthen the field of its graduate work in engineering, the University of Illinois maintains fourteen research graduate assistantships in the Engineering Experiment Station. Two other such assistantships have been established under the patronage of the Illinois Gas Association. These assistantships, for each of which there is an annual stipend of $600 and freedom from all fees except the matriculation and diploma fees, are open to graduates of approved American and foreign universities and technical schools who are prepared to undertake graduate study in engineering physics, or applied chemistry. Information may be obtained by addressing The Director, Engineering Experiment Station, University of Illinois, Urbana, Ill.

Special Entertainments Planned for Institute's February Meeting

In addition to the general program of technical sessions to be held at the 125th meeting of the American Institute of Mining and Metallurgical Engineers, in New York, the Committee on Arrangements has made the following announcement concerning special entertainments:

On Feb. 20, at 8:15, a smoker will be held in the Engineering Societies Building.

On Tuesday evening, Feb. 21, two moving pictures, "Mexico and Its Oil" and "Through India With the Duke of Connaught, Including a Visit to the Tata Iron and Steel Works," will be shown.

For the accommodation of members, arrangements have been made whereby tickets for several of the principal theatres may be purchased through the Entertainment Committee. Details regarding these tickets may be obtained from A. C. Ludlum, 2 Rector St., New York City.

On Wednesday afternoon, Feb. 22, Senator William A. Clark will open his art galleries to members and guests.

Wednesday evening will be devoted to the banquet.

Those planning to participate in the excursions on Thursday, Feb. 23, will assemble at the ferry house of the Central R.R. of New Jersey at the foot of West 23d St. (Hudson River), a little before 9 o'clock, the boat leaving 8:55 a.m. sharp. The party will be divided into groups: those interested in steel, in oil and in copper.

At Jersey City, a special train will take the steel group to the plant of the Crucible Steel Co. of America, at Harrison, N. J.; the oil group to the Bayway plant of the Standard Oil Co. of New Jersey, and the copper group to the Chrome plant of the U. S. Metals Refining Co. At Perth Amboy the different groups will be entertained at luncheon by the industries of Perth Amboy.

After lunch the steel group will visit the Pardee Steel and Pardee Tile Works; the oil group the Chesebrough Manufacturing Co. or the Barber Asphalt Co., and the copper group the Standard Underground Cable Co. or the Raritan Copper Works. The ladies of the party will be entertained at cards and tea during the afternoon. Groups will reassemble at the Perth Amboy station about 4:30 p.m., for return by special train, which will bring them back to New York about 5:30 p.m.

The committee finds that it will be necessary to secure definite registration for the excursions. This registration Tuesday evening, Feb. 21.

Partly to defray the expenses of the excursion, members residing in the territory covered by the New York Section will be required to pay a nominal fee for themselves and each guest when registering for the excursion. Visiting members and guests will not be required to pay this fee.

MEN YOU SHOULD KNOW ABOUT

G. A. Joslin has returned to Salt Lake City from Bayhorse, Idaho.

H. S. Rose, president of Level Crystal Gold Mines, Kirkland Lake, is visiting New York.

C. K. Leith, of the University of Wisconsin, sailed for Chile on Jan. 7, to make geological examinations.

O. E. Meinzer, of the staff of the U. S. Geological Survey, is making a Western trip on extended business.

E. A. Julian, of San Francisco, consulting engineer for the Goldfield Consolidated Mining Co., was recently in Reno.

J. R. Thoenen has been made general manager of the Spar Mountain Mining Co., with headquarters at Cave-in-Rock, Ill.

Maurice Clark has been put in charge of a special mining department recently established by the Douglas, Ariz. Chamber of Commerce and Mines.

George A. Morrison, formerly superintendent of the Creighton Mine, Ontario, has accepted a position with the Keene Mica Co., Gilsum, N. H.

J. D. Bower, formerly shop foreman for the Miami Copper Co., has been placed in charge of the mechanical department at Nacozari, Mexico.

Frank M. Estes returned to New York from Central America last week and left for Madera, Chihuahua, Mexico, to take charge of the Dolores mines.

Arthur W. Jenks returned to San Francisco last week after examining properties in the Porcupine and Kirkland Lake districts of northern Ontario.

William Loeb, Jr., vice-president of the American Smelting & Refining Co., has been in Salt Lake City and vicinity on a trip of inspection of the company's plants.

Bulkeley Wells has been elected chairman of the mining bureau of the Civic and Commercial Association at Denver. He succeeds **Richard A. Parker.**

Stanly A. Easton, of Kellogg, Idaho, manager of the Bunker Hill & Sullivan Mining & Concentrating Co., accompanied by his family, is spending a few weeks in California.

Martin Trewhella, superintendent of the Agnew mine, a property of the International Harvester Co., near Hibbing, Minn., has resigned his position and will move to Los Angeles, Cal.

John T. Reed, who has recently been in San Francisco on business, will soon leave his office in Lovelock, Nev., for an extended visit to New York City in connection with his mining interests.

John C. Semple has severed his connections with the firm of Armstrong & Semple, Spokane, Wash., and has opened offices for the practice of mining engineering in the Shoshone Building, Wallace, Idaho.

A. J. Beaudette, of Los Angeles, will leave on Feb. 1 to establish an office at Istmina, Colombia, S. A. He will remain there about three years, making a geological investigation of the occurrence of platinum in the San Juan River.

W. Earl Greenough, mining engineer of Wallace, Idaho, and Spokane, has returned from the oil fields of Wyoming, where he had been for several months giving his attention to the development of a large oil tract near Lander.

W. L. Cummings, chief mining engineer for the Bethlehem Steel Co., has been visiting the iron-ore districts of the Lake Superior region. He was accompanied by **Mr. Salter**, who is in charge of mining operations for the company at Cornwall, Pa.

Frederick Bradshaw, was elected president at a meeting of the Nevada Mine Operators' Association, held in Reno Jan. 9. Other officers were as follows: **John G. Kirchen**, first vice-president; **W. S. Larsh**, second vice-preident, and **H. M. Rives**, secretary.

W. P. Chinn, assistant general manager of mines, and **W. A. Rose**, chief mining engineer, of Pickands, Mather & Co., have been promoted to the respective positions of general manager and assistant general manager. Mr. Chinn fills the vacancy caused by the removal of **C. H. Munger**, secretary of the company, from Duluth to Cleveland.

Mining and metallurgical engineers visiting New York City last week included: **W. W. Taylor**, New Haven, Conn.; **C. W. Goodale**, Butte, Mont.; **E. W. Bullard**, San Francisco, Cal.; **W. J. Pentland**, Mexico; **Sherwin F. Kelly**, Lawrence, Kan.; **J. F. Callbreath**, Washington, D. C.; **A. E. Perkins**, Salt Lake City; **W. B. Campbell**, Baxter Springs, Kan.; **Harold A. Titcomb**, Farmington, Me.; **W. R. Van Slyke**, Eveleth, Minn.; **H. L. Rau**, Milwaukee; **W. B. Donoghue**, Ontario; **T. J. Mateer**, Fredericktown, Mo.; **E. F. Buchard**, Washington, D. C.; **Charles W. Henderson**, Denver; **H. R. Robbins**, Fierro, N. M.; **Julius H. Gillis**, Sudbury, Ont., and **G. R. Mansfield**, Washington, D. C.

OBITUARY

G. G. Hartley died at his home in Duluth, Minn. on Jan. 17, at the age of sixty-eight. Mr. Hartley was one of the pioneers in mining on the Mesabi iron range, where his greatest achievement was the successful washing and concentration of low-grade iron ores on the western end of the district.

Captain James Rosewall died recently at his home in Hibbing, Minn., after an illness of many months. Mr. Rosewall, who was fifty-five years old, had been chief underground mining captain for the Oliver Iron Mining Co. in the Hibbing district for the last twenty years. He was born in St. Ives, Cornwall, England.

THE MINING NEWS

The Mining News of ENGINEERING AND MINING JOURNAL is obtained exclusively from its own staff and correspondents, both in the United States and in foreign fields. If, under exceptional conditions, material emanating from other sources is published, due acknowledgment and credit will be accorded.

Leading Events

Other copper companies are now looking forward to a resumption of operations on a more or less limited scale. Among these are the United Verde Extension and the Iron Cap, in Arizona, which plan to resume next month, and the Calumet & Hecla and three of its subsidiaries, in northern Michigan. The International smelter in Arizona is now running two furnaces on Miami concentrates. The Davis Daly company is negotiating with Anaconda for the treatment of its ore at the latter's Washoe plant.

Butte & Superior's crosscut on the 2,600 level of the Black Rock mine is in nearly 10 ft. of ore running 9 per cent copper and high in silver.

The Hollinger Consolidated Gold Mines, Ltd., of Porcupine, Ont., has started suit against the Northern Canada Power Co., alleging that it has grounds for action through the latter's failure to conform to the terms of its contract.

Flotation litigation between the Minerals Separation and the Miami Copper companies progressed another very short step recently when the Court of Appeals at Philadelphia refused to shorten the case by excluding the consideration of certain processes, Miami thereby losing the point.

Mergers of various independent steel companies are the subject of much discussion. The situation as it stands is given in this issue.

Freight rates on ores from the Pioche district, Nevada, to the Salt Lake Valley smelters have been reduced, effective next month.

Hearings in the Star-Hecla injunction suit were recently resumed in Spokane.

Hollinger Sues Power Company for Breaking Contract

Operations Greatly Hampered by Power Shortage—Amount Claimed Said To Be Over $2,000,000

The Hollinger Consolidated Gold Mines, Ltd., of Porcupine, Ont., has begun one of the most important legal actions in the history of mining in northern Ontario in its suit against the Northern Canada Power Co., Ltd., for the failure of the latter to comply with its contract to supply the full needs of the mine during the winter months of 1920-1921. It is understood that the amount claimed is $2,150,000, which includes loss in revenue from tonnage which might have been treated had the power been available for extensions, and also includes the New York exchange on such estimated production.

The primary cause of the action dates back to the early days in the history of the Porcupine field. At that time two power plants were being built on the Mattagami River, one at Sandy Falls, which was being financed by Hollinger interests, and the other at Wawaitin Falls, in which the Dome company was interested. These two plants were amalgamated under the name of the Northern Canada Power Co., Ltd., and it is stated that as one of the considerations for turning over the plant the Hollinger company obtained first call on all the power needed for its requirements. At that time neither the power company or the mining companies had any conception of the magnitude to which these mining operations would extend, and when the shortage of water occurred last winter the power output was somewhat curtailed. The Hollinger made application for the right to develop power on the Abitibi River, but as the Abitibi Power & Paper Co. had certain rights to be safeguarded in this connection, the government did not grant the Hollinger's application. Hollinger officials have also stated that they could develop their own power with the use of Diesel engines for less than the power company charges. All these factors have resulted in a serious power shortage in the Porcupine camp, as the power company does not want to go ahead with expenditures without assurance that if additional power is developed it will be consumed. The power situation in the camp has held up its development for at least a year.

Suit To Test Tonnage Tax Law of Minnesota

Oliver Iron and Thirty Independents Claim Statute Is Unconstitutional —Action Forced on Operators

By Wire

Duluth—Suit to test the constitutionality of the Minnesota state tonnage tax on the mining industry was filed in the U. S. Court in Duluth on Jan. 25 by the Oliver Iron Mining Co., and thirty independent mining corporations. Issuance of a temporary restraining order was asked to enjoin officials of the state from proceeding with the collection of the tax. Should that be granted, application for a permanent injunction may be heard before a court of three judges. Suit was forced at this time through the action of the State Tax Commission in serving notice on the mining companies to supply certain information on which the tax could be assessed. The companies would have been liable to penalties had they refused to comply.

Merger of Independent Steel Companies Pending

Negotiations in Advanced Stage — Names of Eleven Companies Mentioned

It is now a well-established fact that negotiations for an important merger of independent iron and steel companies have reached an advanced stage, and that unless a break occurs over the relative valuations of the properties involved the merger will be an accomplished fact by early spring. The plans, if effected, will mean a combine of the Youngstown Sheet & Tube Co., Youngstown, Ohio, and the Inland Steel Co. and Steel & Tube Co. of America, both of Chicago.

Other independent concerns which have been prominently mentioned as entering into the preliminary merger negotiations are the Midvale Steel & Ordnance Co., Pickands, Mather & Co., Lackawanna Steel Co., Brier Hill Steel Co., Pittsburgh Steel Co., Cleveland-Cliffs Iron Co., Donner Steel Co., Otis Steel Co. and Trumbull Steel Co. It is not now expected that these companies will enter into the proposed merger at this time, but it seems probable that one or two combinations may be effected of these concerns, with the ultimate view of forming a large merger of the independent combines later. Pickands, Mather & Co. will in any event be affected by the merger plans, as this company owns important interests in the Youngstown Sheet & Tube Co. and in the Steel & Tube Co. of America. Cleveland-Cliffs has denied that it will enter the merger.

Representatives of the three independents mentioned have been rounding out the details of the merger at meetings held in Chicago, Cleveland,

and New York. A valuation committee composed of the vice-presidents of these companies has appointed umpire engineers, who are now engaged in examining and appraising the iron-ore properties on the Gogebic Range in Michigan and the Cuyuna Range in Minnesota which will be involved in the deal.

The proposed merger will have important steel-manufacturing facilities, a large iron-ore reserve, and a fleet of Lake ships. It is expected that the new consolidation will make its iron-ore and vessel headquarters in Duluth.

The Youngstown Sheet & Tube Co. produces forging ingots, blooms, billets, bars, wire, steel and iron pipe, tubes and sheets; the Inland Steel Co., pig iron, ingots, blooms, bars, structural shapes, plates, and sheets; and the products of the Steel & Tube Co. of America include pig iron, ferrosilicon, ferromanganese, plates, steel pipe, and tubes.

The Youngstown Sheet & Tube Co., though not actively engaged in the mining of iron ore, is reported to own interests in several mine leases. The other concerns in the consolidation are important iron-ore producers in the Lake Superior district. The Steel & Tube Company of America owns and operates the Palms-Anvil group and the Newport mine on the Gogebic Range of Michigan, the last named being the largest and deepest underground iron mine in the world. It also controls, through the Rogers-Brown Ore Co., the Kennedy and Meacham mines, on the Cuyuna Range, with an estimated reserve of about 2,000,000 tons, and the Susquehanna mine, on the Mesabi, with a reserve now estimated at 18,000,000 tons.

The Inland Steel Co. owns and operates the Armour group and the State Lease on the Cuyuna, and the Laura mines, on the Mesabi Range, with a total estimated reserve of 5,700,000 tons, and is interested in the lease of the Dunwoody mine, on the Mesabi, an 11,000,000-ton reserve operated by the Tod-Stambaugh Co.

The financial details of this independent merger of steel interests are being handled by Dillon, Read & Co., of New York. James A. Campbell, president of the Youngstown Sheet & Tube Co., has been mentioned as the probable president of the new corporation.

Katanga To Use Powdered Coal in Blast Furnaces

An agreement has been made whereby the Garred-Cavers pulverized-coal firing process will be applied to the blast furnaces of the Union Minière du Haut Katanga, in the Belgian Congo, Africa, for the smelting of copper ores. U. A. Garred, president of the Garred-Cavers Corporation, left New York on Jan. 17 for the Belgian Congo to supervise the installation of the process. The pulverized-coal equipment was purchased several months ago in America and is now installed at the Katanga smelter.

Calumet & Hecla To Resume Production April 1

Three Subsidiaries Likewise—Output at Start To Be About Half Normal

The Calumet & Hecla and three of its subsidiaries, the Ahmeek, Allouez, and the Isle Royale copper companies, in northern Michigan, will resume production April 1. Men will be taken on from time to time before that date as they may be needed to repair the shafts and plants and to overhaul the equipment. Production at the start will probably not be more than half normal and will be gradually increased as the market warrants. Calumet and Hecla's copper surplus should be back to normal by midsummer.

Navigation will have opened before operations are resumed in the Calumet & Hecla mines, according to present prospects. This will assure a plentiful supply of coal. Though considerable work must be done in the conglomerate shafts before production can get back to normal in this department, it is expected that the amygdaloid shafts will be ready to resume hoisting without great delay. The restoration of underground equipment and the repair of surface plants will not take more than six to eight weeks. No great difficulty is expected in recruiting sufficient labor to reopen the mines. It is estimated there are fully 3,000 men available in the district, and there is no intention of speeding up production at the start.

Freight Rates on Pioche Ores Reduced

New Schedule Affecting Shipments To Salt Lake Valley Smelters Effective Feb. 7

Reduced freight rates on ore shipped from the Pioche district, Nevada, to the Salt Lake Valley smelters will become effective Feb. 7. The new schedule is a result of the hearing recently held at Carson City. A comparison of the new rates with those now in effect is given in the following table:

Ore Not Exceeding in Value	Rate After Last Increase	Plus War Tax	New Rates
$6.50	$2.75	$2.83	$2.20
7.50	2.75	2.83	2.75
8.50	3.50	3.60	2.80
10.00	3.50	3.60	3.50
15.00	4.25	4.38	3.75
20.00	5.50	5.66	4.50
30.00	7.00	7.21	5.50
40.00	8.25	8.50	6.25
50.00	9.38	9.65	7.00
60.00	10.12	10.42	7.50
70.00	10.50	10.82	7.50
80.00	11.00	11.33	8.00
90.00	11.37	11.71	8.50
100.00	11.75	12.10	8.50
150.00	14.13	14.55	10.00

The value of the ore is computed by dividing the amount derived from the smelter settlement by the wet tons contained in car after smelter has deducted its own charges.

Ore shipments from the Pioche district for the week ended Jan. 13 were confined to ore from the mines of the Bristol section, where the Bristol Silver shipped 315 tons and the Black Metals 315 tons. All other ores are being held pending the application of the new rates.

Mineral Discoveries Made in Silesia

By Cable From Reuters to "Engineering and Mining Journal"

Prague, Jan. 16—According to the *Narodni Listy* discoveries of gold have been made in Czechoslovak-Silesia. Two analyses revealed 36 and 52 grams of gold respectively per ton of ore. Ore containing copper and iron has been found near Durrseifen. Pyrites has been discovered near Zuckmantl, and magnesite near Vidnava. Several foreign groups are already interested.

U. V. Extension Will Resume Next Month

James S. Douglas Seeking Lower Rate on Bullion to Pacific Coast

James S. Douglas, president of the United Verde Extension Mining Co., Jerome, Ariz., has announced that his company expects to resume production within thirty days, with an output of 1,500 tons of bullion a month and with an operating force of 500 men. He is working on a new plan, which is expected to secure a material reduction in transportation costs, with incidental transfers of freights to San Pedro harbor, on the Pacific Coast, instead of direct rail shipment to New Jersey for refining. He has enlisted the support of the Los Angeles Chamber of Commerce in his efforts to secure a rail rate of $5 a ton for domestic and $4 for export copper bullion from Jerome to Pacific tidewater, 570 miles. He considers this fair in view of the present Salt Lake-Los Angeles rate of $6.50. The Arizona-New Jersey rate is $16.50. Before the war the Atlantic rate was $12.50. Los Angeles already is making plans for a refinery at her harbor, to manufacture Arizona copper into such forms that it can be exported directly to the Orient, with possibility of attached wire and other manufacturing plants.

Court Refuses To Curtail Miami Flotation Suit

On Jan. 18 the U. S. Circuit Court of Appeals, in Philadelphia, heard and denied a petition for a writ of mandamus, which, had it been granted, would have instructed the master who is making the accounting in the Miami Copper Co. flotation suit to exclude from the accounting proceedings further consideration of those flotation processes of the Miami company which have been employed subsequent to those which the Circuit Court of Appeals had found to be infringement. This unusual petition resulted from an equally unusual situation. In 1920 Minerals Separation, Ltd., appealed to the U. S. District Court seeking to have the Miami Copper Co. found in contempt of court for its continued use of these subsequent processes. But the Minerals Separation, Ltd., having failed in its efforts before the District Court, in this respect, because that court did not find these subsequent processes to be "mere

colorable departures" from the declared infringing processes, made further effort to bring the matter to the higher court upon appeal. The Circuit Court of Appeals decided, however, that such an action was not appealable, but wrote an opinion in which it sustained the District Court's opinion to the effect that the Miami company's operations were not such as to make them in contempt.

Upon the apparent contention that that which could not be found in contempt could not be found to infringe, the Miami sought the aid of the court to eliminate from the hearings before the master further testimony as to these subsequent processes. The Circuit Court of Appeals, however, decided that the record was already so voluminous that it was better that the defendant make its reply before the master, rather than through the medium of a new trial.

Star Injunction Hearings Resumed

Hearing of injunction proceedings brought by Eugene R. Day and Sarah E. Smith, minority stockholders in the Hecla Mining Co., Wallace, Idaho, to restrain Hecla company from joining with Bunker Hill & Sullivan Mining & Concentrating Co. in acquiring a joint interest in property of Star Mining Co. at Mullan, Idaho, was resumed at Spokane, Wash. on Jan. 16. The original plaintiffs have been joined in the action by Frank Murphy, Frank Radovich, and A. L. Hutton, Hecla stockholders to the extent of about 11,000 shares. Indications are that examination and argument will take a week or ten days, with an appeal to higher courts, without regard to the side favored by the decision.

Only half of the plaintiff's witnesses had been heard up to Jan. 24. Among the technical witnesses for that side were F. E. Berg and Roy Wethered, of Wallace, of the Day companies' engineering staffs; A. L. Bruce, of Butte, manager of the Davis-Daly Copper Co.; and Sidney L. Shonts, of the Internal Revenue Department, Washington, D. C. The technical evidence has been confined largely to the refractory nature of the Star ores and the impossibility of profitable mining operations under the arrangement proposed by the Hecla and the Bunker Hill & Sullivan companies.

Many important technical witnesses are lined up for the defendant, including Albert Burch, of San Francisco; W. H. Wiley, of Los Angeles; F. W. Callaway, of Kellogg, Idaho; Rush J. White, of Wallace; W. G. Woolf who is in charge of the Bunker Hill electrolytic operations; D. W. Buckby, superintendent of the Timber Butte mill, Butte; Gus Hellstrand, metallurgist at the Timber Butte mill; A. J. Miller, of Salt Lake City; and J. B. Parker, of Kellogg. Important evidence is likely to be given by Fred W. Bradley, president of the Bunker Hill & Sullivan company.

To Reopen Cornish Radium Mine

By Cable From Reuters to "Engineering and Mining Journal"

London, Jan. 21—Great interest has been aroused in Cornwall by the announcement that an English financial group has decided to reopen the Tolgarrick radium mine, near Truro. The property is known to possess two rich lodes of uranium ores, and it is hoped to establish a new industry in Cornwall by treating the ore on the spot.

Another Option on Middlemines on Comstock Taken

As announced recently, an option on the Middlemines group of the Comstock lode has been granted to Dr. M. R. Ward and associates, of Philadelphia. The sum of $150,000, to defray expense of examination and necessary development work, has been raised, and work started through the Hale & Norcross tunnel under direction of Alex Wise. The properties included in the option are credited with a production of over $100,000,000 in high-grade ore. Present plans are to develop and prove the commercial low-grade portion of the lode, with the possibility of later driving haulage tunnels and erecting a mill of at least 2,000 tons' daily capacity.

Archibald-Osborn Case Settled

In the matter of the suit of Ralph S. Archibald, of Negaunee, Mich., against Chase S. Osborn, of Sault Ste. Marie, and others conducting the sale of lands of the Michigan Land & Iron Co. to the Ford Motor Co., for service rendered in connection with that sale, the issue has been settled out of court and to the complete satisfaction of Mr. Archibald. Berg, Clancey and Randall were attorneys for the plaintiff. Mr. Archibald is a geologist and mining engineer representing regularly several large mining interests in the Lake Superior country.

"Pittsburgh Plus" Case To Open

Tenative arrangements have been made by the Federal Trade Commission to begin the trail of the Pittsburgh basing point case against the U. S. Steel Corporation at Milwaukee on Jan. 30. This case is based on a complaint issued by the commission against the corporation for alleged prejudice against competitors in the use of the "Pittsburgh Plus" method of fixing the price of steel.

McDougall Patent Case Appealed to Supreme Court

The case against the Oliver Iron Mining Co. instituted by Alexander McDougall has been taken to the U. S. Court of Appeals. The plaintiff alleges infringement of patents granted himself on ore washing equipment and seeks damages alleged to have been sustained for over $1,000,000. At the first trial in the United States District Court, about a year ago, the decision rendered was in favor of the Oliver Company.

Operations Along Kuskokwim Progressing

Gold Stampede to Tributary of Nixon's Fork—Guarding Gold Shipments

BY DUKE E. STUBBS

Aniak, Alaska, Nov. 1—The season of 1921 closed on the Central Kuskokwim River without any sensational rich strikes, but nevertheless with steady improvements. Drilling with a gasoline-driven drill was begun on Ophir Creek, testing for placer gold. The work was abandoned before the close of the season, because of the poor showing made. A hydraulic outfit that has been in process of installation for the past two years was worked on Spruce Creek. Good results were obtained.

During the spring and early summer New York capital acquired a group of fifty-two placer claims of twenty acres each on California Creek and the Upper Tuluksak River for dredging. A steam-driven drill will be installed to test the ground during the coming summer.

BRINGING GOLD SHIPMENTS DOWN KUSKOKWIM RIVER, ALASKA, WITHOUT GUARDS

Several small outfits continued to mine on Bear Creek during the season with the pick and shovel. Shaft sinking continued during summer and fall on the quartz prospect in the Russian Mission Mountain, fourteen miles from Kolmakoff. Those concerned claim they are developing a big orebody carrying values of $90 per ton in tin. A small crew worked with an hydraulic outfit on Marvel Creek, in the Aniak region, the last summer.

The new quicksilver mine twenty-two miles from the mouth of Crooked Creek was operated during summer and fall with only three retorts, due to the freezing in of the river boat the fall before and to the impossibility of sledding in the complete plant until snow came. The ore runs high in mercury and the mine promises to become a heavy producer soon.

A rich placer strike was made on Crooked Creek last summer, going $2

per sq. ft. of bed rock, and preparations were started for installing a hydraulic plant next season. Lumber is now being hauled on the ground from Iditarod.

Rich ground was found on Willow Creek, a tributary of the George River, and a new hydraulic outfit is being landed on the ground this winter for work next season. The largest nugget to be found on this part of the Kuskokwim River, weighing 16½ oz., was found on a George River tributary.

A small crew have been at work the past season at the Parks cinnabar properties, fifteen miles above Georgetown, but shut down at the freeze-up.

Development work was continued during the summer on the Holitna River, and resulted in a stampede up the river. Some good pay is reported to have been struck there. No mining has yet been done.

A very rich strike of placer gold was reported on a tributary of Nixon's Fork, late in the summer, and has resulted in a great stampede since the freeze-up, hardly an extra man being left in any of the camps on the Central River. Good prospects have been found along six miles of the benches. The Treadwell's quartz mine shipped several barges of rich ore last summer to the outside. The company has received and installed larger air compressors, and expects to increase the output of ore next summer. About half a dozen new placer camps are getting ready to work the summer of 1922, in the vicinity of the Treadwell property.

The first dredge on the Kuskokwim River made a half-million-dollar shipment of gold bricks this fall by the last boat for the outside. The ground is dredging much better than was shown by some of the drill reports.

Four new dredges are enroute to the Kuskokwim. Some are being shipped by way of the mouth of the Kuskokwim; one around from Nome by way of the mouth; another over the snow to Ruby, on the Yukon, and will come around by water, next summer; and one is being hauled over land to the head of the river. Another dredge is ready to be shipped from San Francisco as soon as space can be reserved on the boats.

GUARDING GOLD SHIPMENTS

Many different plans have been adopted in the past by captains of river boats to safeguard large and valuable shipments of gold, generally by placing the treasure in iron boxes secured by two or more padlocks, the whole then being chained and locked to the mast or some part of the machinery, and watched by several guards. But it has remained for the captains of the steamers on the Kuskokwim River to evolve a plan that is original and appears to be wholly safe for the treasure. The gold is put in strong wooden, iron-clad boxes and delivered under strong guard to the steamers. The boxes are laid along the floor, and 4-ft. steamboat wood, used as fuel, corded on top. Thus the gold makes its 600-mile journey down river to the ocean boat. The steamers use many hundreds of cords of wood, and it would be utterly impossible for hold-up men to get the gold without removing the greater part of the cord wood. As the crews of these boats are composed of Esquimo, the highwaymen would need to speak the native tongue to secure help from them, and if he tried to force them with a gun, they would either jump overboard or faint. It has been estimated that it would take two highway robbers fifteen hours to unload the wood so they could get at the gold, and as working is a violation of the Highwaymen's Union rules, they would be fined more than they got if attempted that way. The express companies might profit thus.

NEWS FROM WASHINGTON

By PAUL WOOTON
Special Correspondent

Hearing on Mining Law Revision Expected Next Month

Chairman Rhodes Opposed to Introduction of Modified Bill — Many Complain of So-Called Arentz Measure

Though it has been necessary to delay somewhat the opening of hearings on the bill providing for extensive revision of the mining laws and for their codification, Representative Rhodes, the chairman of the House Committee on Mines and Mining, is fully determined that the committee proceed with these hearings at the earliest possible date. In all probability, the hearings will begin early in February.

Of the communications being received by the committee in regard to the bill, fully 90 per cent, Mr. Rhodes says, are protests against some feature of the measure. In view of the widespread complaint which has been registered against the bill now before the committee, it has been suggested that a modified bill be introduced and made the basis of the hearings. Mr. Rhodes sees nothing to be gained by such a course and insists that the bill introduced by Representative Arentz, of Nevada, be made the basis of the hearings. He believes any other course would tend toward confusion.

The Arentz bill has been widely circulated, and all correspondence and discussion have been directed at that measure. In addition, Mr. Rhodes personally made an extended trip through the mining states and has listened to first-hand testimony of representatives of the industry who reflected opinion typical of that prevailing in various districts. At these hearings and at all other times Mr. Rhodes has refrained from stating any conclusion that he may have reached himself. He believes, however, that the Committe on Mines and Mining will be able to reach a decision promptly.

It has been suggested to Mr. Rhodes that, in view of the opposition, it may be better to undertake to secure legislation at this time in the matter of extralateral rights only. Were the committee to report out a bill providing for vertical side lines, making it clear that the change is in no way retroactive, it is believed that it could be passed. Mr. Rhodes states that this proposal will be emphasized during the hearings, and should it develop that this course is regarded as being best, he sees no reason why a less controverted feature of the bill could not be handled as a separate measure, leaving the more disputed provisions for further discussion. He points out that the committee can report out the type of bill that it agrees upon as being best and is not limited by, or committed to, the bill on which the hearing is based.

Tariff on Cyanide Favored by Senate Committee

Expected To Recommend Rate Lower Than That Asked—Chemical Company Said To Control Field

Unquestionably the controlling sentiment within the Senate Finance Committee favors a duty on cyanides. It is probable that a rate lower than the 33⅓ per cent duty requested will be prescribed in the bill which will be reported to the Senate next month. It may be predicted, however, with considerable certainty that cyanides will be removed from the free list.

Though the Homestake Mining Co. has been most active in opposing a duty on cyanides, its position is generally understood to be that of the gold-mining industry in general. The principal point made before the committee was that the gold-mining industry is in no position to add to the expense of producing its fixed-valued product. It was pointed out that though there were twelve regular gold producers in the Black Hills four years ago, only two, the Homestake and the Trojan, have survived the war period. Under those conditions, the committee was urged to do as the Ways and Means Committee had done with the bill in the House and insist upon cyanides remaining on the free list.

Senator Smoot, of Utah, called atten-

tion to the fact that only two-tenths of a pound of cyanide is used in treating a ton of ore at the Homestake mine. As the price of cyanide for the last eight years never has exceeded 25c. a lb. to those using it in quantity, he expressed the opinion that it is not going to add greatly to the cost of production of gold, when the cyanide used would not cost to exceed 5c. per ton of ore treated.

Senator Sterling, of South Carolina, referred to the committee a letter in which it was charged that there is an agreement between the Roessler & Hasslacher Chemical Co. and the German and English manufacturers of sodium cyanide. It was suggested that they are dividing the world markets.

P. S. Rigney, appearing for the Roessler & Hasslacher company, suggested that the letter probably came from a disgruntled former employee and declared that there has been no division of territory with English and German producers. He stated that the majority of the stock of this company and its subsidiaries is American owned. He characterized as "absolutely and unqualifiedly untrue" statements to the effect that the Alien Property Custodian took over the Roessler & Hasslacher company during the war. He said that the company is an American institution, employing American labor, and paying taxes to the United States. He pointed out that cyanide always had been dutiable, prior to the Underwood tariff. The Payne-Aldrich rate was 25 per cent. If cyanide is put on the free list, he said, it would be necessary to close the company's plants and scrap $5,000,000 worth of property. Mr. Rigney said that his company is importing cyanide to supply many of its customers and laying it down at New York 6c. cheaper than it can be manufactured for in this country. Such cyanide as is being manufactured is produced at a loss, he said, and its production is justified only by the advantages of holding the organization together.

J. O. Hammitt, of the American Cyanamid Co., expressed the opinion that it would be greatly in the interest of the American consumer to permit a continuance of competition between cyanide producers. He pointed out that his company is an American enterprise that was unable, in 1907, to obtain the cheap water power necessary for the manufacture of cyanamid and for that reason had established a plant across the river in Canada. After declaring that chemical manufacturing companies generally recognize that Roessler & Hasslacher has definite control of the field and constitutes an American monopoly, Mr. Hammitt stated that customers had told him that they had been handed unreasonable contracts and were required to enter into them as the only basis upon which they could obtain cyanide. He quoted President Seaman of the Trojan Mining Co. as authority for the statement that a representative of Roessler & Hasslacher had laid on his desk a contract for his full requirements for three years and stated that he could get no cyanide until he signed the contract. In 1917, the American Cyanamid Co. entered the American market, and Mr. Hammitt said it is now in a position to offer real competition and to break up the character of exploitation which he alleges existed previously.

Plan Hearing on Nicholson Bill Before Senate Committee

Thought Likely Joint Commission on Federal Reorganization Will Not Propose Department of Mines

Immediately following the report of the joint commission which has been studying the matter of Federal reorganization, it is planned to call a preliminary hearing before the Senate Committee on Mines and Mining on the bill of Senator Nicholson, of Colorado, which provides for the establishment of a Federal Department of Mines. Though no announcement has been made as to the recommendations which the commission will make, it is assumed that the plan proposed will not include a department of mines. The submission of the report will bring the whole subject prominently to the attention of members of Congress.

The subject is now receiving the active attention of legislators, and Senator Nicholson is of the opinion that this would be a propitious time to bring up his bill. His plan is to have a preliminary hearing before a subcommittee of the Mines and Mining Committee, at which a record could be made of the thought on this subject of outstanding men in the mining industry. This concise testimony could be made immediately available in printed form and could be distributed widely. After an opportunity has been given the public to acquaint itself with the advantages to be gained from such a department, it is planned to conduct more formal hearings, at which all interested in the proposition could be heard, as well as those who are opposed to it.

NEWS BY MINING DISTRICTS

London Letter

Report Made on East Pool-South Crofty Pumping Dispute — Gaika Gold Directorate Changed — Russo-Asiatic Approached by Soviet

BY W. A. DOMAN

London, Jan. 10 — Forster Brown, mining engineer, who was appointed by the Board of Trade to hold a public inquiry in Cornwall into the dispute between the East Pool and South Crofty companies in regard to pumping, has now issued his report. As I mentioned at the time, the closing of a part of the East Pool mine threatened to flood the South Crofty, and the question in dispute is as to which party is responsible for keeping down the water. According to Forster Brown, a sum of £42,000 would be necessary for pumping machinery, and annual pumping charges would run into about £17,000, and his recommendation is that 62 per cent of the cost should be borne by South Crofty, and 38 per cent by East Pool. South Crofty management welcomes the idea, but East Pool raises objections. The position is not easy to understand, for East Pool would not be unwatered below the 180-fathom level, though it would appear that the company has already abandoned this part of the workings. If the plan as recommended by Forster Brown could be carried through, the South Crofty might be able to resume mining operations in about twelve months.

As I recently reported, trouble has arisen in connection with the management of the Gaika Gold Mining Co., in Rhodesia. Stanley J. Edwards, a Colonial, and a substantial following that he has secured, have taken such action that three of the directors, one of them the chairman, have resigned. Mr. Edwards' allegation is that the mine could have been operated to better advantage so far as the shareholders are concerned. The directors, in a long circular, met all his points, and it looked like a fight. At the last minute resignations were handed in, and Mr. Edwards has a board of his own appointing. His intention now is to send an independent engineer to the mine to report and reorganize. The movement seems to be a reflection upon the management of engineers supplied by the Gold Fields Rhodesian Development Co.

The Russo-Asiatic Consolidated has received a message from its Moscow agent to the effect that the Soviet government desires to resume negotiations for the return of the company's properties. Further encouraging news has come to hand from the company's Villemagne concession in France, borehole No. 18 indicating at a depth of 300 ft. a width of 6 ft. of ore assaying 8 per cent lead, 10 per cent zinc, and 3 oz. silver per ton. The management is testing this property by the drill in the same way as it proved Irtysh, Kyshtim, and Tanalyk.

Apart from the gold premium, the

Cam & Motor Gold Mining Co. has not yet earned much profit. For instance, the October net profit was £4,520, including £4,500 from premium reserve; for November, the net profit was £4,502, including £4,000 from premium reserve. The crux of the position is the tonnage that can be crushed monthly. The company uses ball mills and the cost is nearly 5s. per ton milled. It did not select these mills; they were on the spot, and, being less expensive than a new gravity plant, were made use of.

There are several new mining flotations on the tapis. Two well-known engineers have reached this country from Australia. One has tin properties for sale, and the other has in his pocket copper properties in North Queensland. From a study of inland Queensland and New South Wales, the latter has come to the conclusion that some fine properties are awaiting development. The trouble at present is to raise capital.

Johannesburg Letter

Strike Over at Crown Mines—Rand Refinery Holds First Meeting

BY JOHN WATSON

Johannesburg, Dec. 6—The strike of workers at the Crown Mines has been settled and the miners returned to work Dec. 5. The stamp-mills were to be restarted as soon as there was enough ore.

The first annual meeting of the Rand Refinery, Ltd., was held on Dec. 5, when H. O. Buckle, president of the Chamber of Mines, traced its history, showing that as a result of researches by Dr. Caldecott and Samuel Evans it was decided to erect and equip a gold refinery on the Rand. The union government, conjointly, has decided to reopen the Pretoria mint. The new refinery is situated near Germiston, on ground purchased from the Simmer & Jack Proprietary Mines, Ltd. The refining plant and buildings, erected under the supervision of Messrs. R. R. Kahan and R. C. Atkinson, will form one of the largest and most up-to-date refineries in the world.

MEXICO

Sonora

Cananea Consolidated Working 700 Men

Cananea — Seven hundred men are employed at the several mining properties, smelter, and mill of the Cananea Consolidated Copper Co., on which, according to E. T. Koons, chief clerk of the general office, about $1,000,000 is being spent on improvements. Mr. Koons has a force of ten men engaged in figuring transportation costs, with a view to determining the possibility of making a saving in utilizing the proposed rail route from Ajo to the Gulf of California, with connection with deep-water vessels that would reach New York via the Panama Canal.

It is reported that the Southern Pacific of Mexico will resume service into Tepic, in the state of Nayarit, Mexico, on Feb. 4 after suspension of about ten years due to revolutionary conditions.

CANADA

Ontario

McKinley-Darragh To Resume This Spring—Canadian Associated Goldfields Meeting Stormy

Cobalt—It is understood that the McKinley-Darragh will start operations in the spring, as soon as the heavy expense for heating is over. It is believed that total costs of at least 60c. an ounce can be obtained.

The Right-of-Way is proposing to open up the south end of its property, where there is supposed to be a considerable tonnage of milling ore.

Porcupine—It is understood that the Dome is making arrangements to make such changes in the company's charter as will permit repayment of capital. It is expected that a meeting of the shareholders will be called within the next two months to ratify changes necessary to permit the company to do this. The company has about $2,000,000 available. A capital repayment of $1 per share would call for $447,000.

The recent discovery of spectacular gold samples on the claims of the Lightning River company will probably result in great interest being taken in that region as soon as the snow is off the ground.

Negotiations are under way for the refinancing of the Clifton Porcupine Mines. This company has a small vein of fairly high-grade ore.

Kirkland Lake — A meeting of the shareholders of the Canadian Associated Goldfields, Ltd., was held in Toronto recently, at which the officials of the company were subjected to much criticism. Some of the shareholders claimed that there was a discrepancy of over $50,000 which was not shown among the expenditures. They also criticised the fact that the company's manager was not there and that no report was available from him. The president took the stand that there was no reason why the manager should be there, but finally agreed to present a report from him within the next three months. The company is capitalized at $30,000,000.

Underground development at the Tough-Oakes continues. Mining is being centralized at the No. 3 shaft of the Burnside, which has been sunk to the 400 level. Surface equipment is being overhauled, and it is expected that milling will be resumed this spring.

British Columbia

Smelter Smoke Damage Cases Before Arbiter at Trail—Activity in Cariboo Expected

Quesnel—Renewed activity in the Cariboo gold fields is looked for early this year. A road to the gold fields of the Whitewater district has been surveyed and will be built in from Hanceville. For the present interest is chiefly centered in Cedar Creek, where new locations have been made.

Trail—Twenty-five cases of farmers of the Trail Creek Valley who are claiming damages from the Consolidated Mining & Smelting Co. for alleged loss by smelter fumes are being heard by the arbiter, Judge Forin. It is believed the hearing will not be concluded until near the end of the month. Over half of those who had claims reached an agreement and satisfactory settlement with the Consolidated company.

Trail—Ore shipments received at the Consolidated smelter from Jan. 8 to Jan. 14 inclusive totaled 8,703 tons, of which 8,306 came from the company's mines. The other shippers were as follows: Josie, Rossland, 91 tons; Knobhill, Republic, Wash., 106; Millie Mac, Burton, 15; Paradise, Lake Windermere, 80; Rambler (lead), Rambler, 25; Rambler (zinc), Rambler, 79, and Wind Pass, Chu Chua, 1.

Sandon — Silversmith Mines, Ltd., which has just started milling operations at its rebuilt 150-ton plant here, will be in a position to maintain regular dividend disbursements to shareholders about the middle of 1922, according to an official report of the board of directors, just issued. The mine and mill are in condition to continue steady production, and it is announced that an output of 500 tons of concentrates per month will be maintained. Ore reserves are conservatively estimated as sufficient for five years.

Nelson—Prospects of improved marketing arrangements for shippers of Slocan and Ainsworth district silver-lead ores are apparent to many Kootenay mining men as a result of action taken by United States Senator Poindexter in urging upon the United States Government the advisability of making some arrangement with the government of the Dominion of Canada whereby the ores of either country may be shipped across the line to smelters for treatment in bond, thus providing for the return and marketing of the metallic contents in the country of their origin without a duty. This is particularly the case with lead, which has to pay a duty of 1c. per lb. when returned after smelting. Such an arrangement would prove particularly beneficial to many British Columbia silver-lead operators and to such mines as the Electric Point and Gladstone Mountain, in Washington.

Vancouver—The existing regulations for the disposal of mining claims on dominion lands provide that all grants or leases are subject to the provision that all ores mined from such locations shall be treated in Canada so as to yield refined metal. An Order-in-Council has been issued by the Canadian government permitting the treatment outside Canada for a period of one year from Dec. 1, 1921, which may be extended by the Minister of the Interior to five years, of the silver-lead ores of the Mayo district of Yukon Territory. The reason assigned is that the only Canadian smelters on the Pacific Coast at which this ore could be economically treated are at Trail and Anyox, B. C., neither of which is prepared to accept the Yukon ore for treatment.

ARIZONA

United Verde To Resume Steam Shoveling Capping—Iron Cap To Start Feb. 1

BY JAMES H. MCCLINTOCK

Phoenix—The Jerome-Superior row at Jerome has reached a stage of criminal prosecution. In Los Angeles, under a grand jury indictment, George Mitchell, one of the best known of Southwestern mine and smelter men and former general manager of the Jerome corporation, has been arrested, also Melville Frasier, former president of the company. It is charged that, by evidence of a fraudulent diamond-drill core, showing very rich ore, they sold stock of par value of $1,300,000. It is alleged that the ore did not come from Jerome-Superior ground and that the ground had not been drilled. Assumption was involved that the cores had been secured by drilling operations in the United Verde that had extended over into the Jerome-Superior. The Mitchell management of Jerome-Superior was deposed by court order after a couple of conflicting meetings of stockholders, reviewed by judges in Los Angeles and Prescott. The holdings are among the largest in Jerome district, including 113 claims. They now are under charge of Bert Campbell. Only assessment work has been done for the last year.

Federal Judge Sawtelle at Tucson has refused permission for issuance of any more receiver's certificates and has set Feb. 16 for the sale of the property of the Consolidated Arizona Smelting Co., at Humboldt. It is understood that on the sale date the Southwest Metals Co. management expects to have available $500,000, with which to buy in the property and pay off debts.

The application of the Arizona Swansea R.R. Co. for permission to abandon its line of twenty-one miles between Bouse and Swansea again is before the Arizona Corporation Commission, with keen opposition from the Swansea mine interests. With exception of one year, the road, since its construction thirteen years ago, has never paid its expense, and it is delinquent in taxes for three years on an assessment of $7,000 a mile. Opponents of the proposed plan of discontinuing operations declare the road essential to operation of the Swansea mine, which is under bond to the Consolidated Arizona Smelting Co.

Douglas—J. S. Williams, Jr., who is manager of the Moctezuma Copper Co., states that renewal of milling operations at Nacozari hardly can be possible before July of this year, when the work of building a new concentrator and of remodeling the old plant will be completed.

Globe—A second reverberatory is in operation at the works of the International Smelting Co. at Miami, with enough Miami concentrates stored to keep the two furnaces busy till May 1, with a monthly output of 16,000,000 lb. of blister copper. Two carloads of sulphide, for flux, are being brought in daily from the Calumet & Arizona mines at Warren, this made necessary by the idleness of the Old Dominion mine in Globe. The smelter company purchased the Miami concentrates several months ago, exchanging copper bullion. About 250 men are employed.

Soon after Feb. 1, nearly a year from the date of suspension, there is to be renewal of operations at the Iron Cap. Mill operations may be delayed, awaiting receipt of roller bearings from Sweden. The concentrates are to go to the International smelter, under a contract still in force.

Globe now has an Asbestos Clearing House Association, for the benefit of small producers, who thus will be able to assemble their outputs for grading and shipment. The first asbestos claims here patented are those of the Arizona Asbestos Association, twenty-one in number, the notice just filed with county recorder.

Morenci — Captain J. P. Hodgson, general manager of the local Phelps Dodge property, announces that no early operations are planned, except reconstruction and additions to equipment. No. 6 concentrator is to be enlarged to 5,000 tons capacity, with changes expected to give a larger percentage of extraction.

Superior—At Superior a 40 per cent force is employed in the Magma, concreting the main shaft and guniting the stations, work that will take until some time in March. It is reported that the Magma management has plans for broad-gaging its rather temporary narrow gage from Magma station on the Arizona Eastern line and for installation of a reverberatory furnace near the mine.

Jerome—Steam-shovel work is to be resumed soon on the United Verde capping ores, which in the meantime are to be loosened by blasting. Original plans for clearing off the whole top of the orebody have been modified. There is to be deep channeling through to the old Glory Hole, exposing the top of the smoldering sulphide stopes section, this first work involving removal of 100,000 cu.yd. of material. The ore is to be handled through the mine and the Hopewell tunnel, as are the mine ores. In all, above the 400 level, 3,000,000 cu.yd. of ore and 4,500,000 cu.yd. of waste are to be removed. The ore will be largely oxide, some of which carries good values in gold and silver, but hardly over 1 per cent in copper. Two shifts are to be employed, with about 125 men. No intimation is given of any plans to resume production at the Clarkdale smelter.

Verde Central is believed to have demonstrated its position as a mine. Excavations for station and sump at the 600 level of the main shaft are in ore, bornite and chalchopyrite in Yavapai schist, with copper value up to 5 per cent. The stock has jumped several dollars, but little is to be had. Much of it was taken in by Calumet & Arizona interests when treasury stock was sold for development needs.

MONTANA

Butte & Superior Cuts Copper Vein on 2,600 Level — Anaconda To Open Fifth Mine Soon

BY A. B. KEITH

Butte—The Butte & Superior company has cut its copper vein on the 2,600 level of the Black Rock mine. The crosscut heading is in nearly 10 ft. of ore that runs 9 per cent in copper and high in silver. The ore is 11 to 15 ft. wide on the 2,200 level. It will be necessary to drift about 200 ft. to reach a point under the 2,200 level where the copper ore is being found at its best. It is considered probable that the company will give consideration to the matter of sinking its main working shaft to the 3,000 level and crosscutting the copper vein again at this depth, in addition to the development of the Rainbow fissure, which is the company's big zinc-silver producer.

Anaconda has resumed mining operations at the Leonard, Mountain View, Badger State, and Steward mines and as soon as heavier rails can be laid at the Mountain Consolidated operations will be started there. A change from mule to electrical power is being made at the last-named property, and it will be necessary to lay about seven miles of track. The decision to reopen the Mountain Consolidated indicates that the Anaconda has enlarged upon its original plans to resume the production of copper at four mines. Ore is now going to the Washoe smelter at Anaconda. Increased activity is noticeable at the Great Falls plant of the company, particularly in speeding up the output of zinc. The electrolytic plant had been producing about 2,000,000 lb. of zinc monthly, but under the Anaconda's contract with the Butte & Superior this will be increased immediately to 4,000,000 lb. monthly and will be further increased to 7,000,000 lb. as soon as milling operations of the Butte & Superior are resumed. Repair work is being pushed at the Black Rock concentrator of the latter company. Shipments of concentrates are being made from the company's stockpile. The upper levels of the Black Rock mine are also being cleaned up preparatory to resuming the mining of zinc ore when the concentrator is ready.

The Davis-Daly Copper Co. is changing its surface haulage system from gasoline to electricity, which will be more economical. The company will probably ship its ores to Anaconda's Washoe plant as soon as the latter is ready to take custom ores.

Libby—The Lukens-Hazel mine, near Libby, has resumed production, the new concentrator, which was completed only a year and a half ago, only to remain inactive, having started on Jan. 1.

More than 51 per cent of the stock of the American Brass Co. has been deposited by the stockholders under the agreement between the Anaconda Copper Mining Co. and the committee.

MICHIGAN

Marquette Range

Cleveland-Cliffs Will Not Enter Merger —Pumping of North Lake Delayed —Ford's Mine Producing—Furnaces Preparing To Resume

BY W. H. NEWETT

Ishpeming—Officers of the Cleveland-Cliffs Iron Co. deny that they are considering entering any of the steel mergers that are being discussed in the newspapers. The management takes great pride in operating its various properties in the Lake Superior region and does not care to do anything to lose its identity.

The Imperial mine, now owned and operated by the Ford motor interests, has stopped all surface construction work until spring, when weather conditions will be more favorable, and is now confining its efforts to mining, the ore being stocked at the mouth of the shaft. The Ford scale of $6 a day is paid to all employees, whether engaged on surface or underground.

The unwatering of North Lake by the Cleveland-Cliffs Iron Co. was hampered recently by the giving way of the ice on which an electric pumping plant was being operated, which let the pump go to the lake bottom, 30 ft. below the surface of the water. The pump is now being recovered.

The installation of the new pumping plant is under way at the Lake Superior mine of the Oliver Iron Mining Co., at Ishpeming.

The Pioneer blast furnace, at Marquette, is undergoing repairs preparatory to blowing in. Several hundred men have also recently been engaged for the wood-cutting forces to supply the kilns with wood for charcoal.

Menominee Range

Iron Montain—The West Chapin Mining Co. held its annual meeting on Jan. 9, selecting officers and directors for the present year. Construction work on the new stack is delayed for lack of materials. Foundations for the stack and stove are ready, and the hoisting machinery and castings are on the ground.

In the Crystal Falls district mines, surface wages are now based on a scale of 21c. an hour for a ten-hour day. Wages underground have been fixed at $3 a day of eight hours where men are working in wet places, and at $2.88 a day where work is conducted in dry places.

Gogebic Range

Mikado Mine Shut Down—Fire in East Norrie Mine

Ironwood—The shaft at the Mikado mine has been closed for an indefinite period, and the small force of men employed there are removing pumps, pipes and rails. At present all stripping and mining operations have ceased in the Wakefield district and many men are idle.

A fire occurred recently on the 18th level of "D" shaft of the East Norrie mine. It was near the transfer shaft and threatened to spread through the Norrie mine, but was got under control twelve hours after being discovered. It started in an old drift used for storing pipe, where some men had been working. Bursting of air lines when filled with water caused a long delay in getting water on the fire. Oxygen breathing apparatus was used in the work.

MINNESOTA

Only Seventeen Seek Prospecting Permits

St. Paul—On the opening of applications for permits for prospecting on mining properties in the State of Minnesota, it was found that there were only seventeen applications. The small number can be attributed to the general depression in the iron and steel business at present and to the unfavorable taxation laws. The stipulations as to the granting of the permits called for payment of $50 for the permit and a minimum royalty of $1,250 for the first year and $5,000 a year thereafter.

Mesabi Range

Lincoln Mine Being Reopened—Butler Bros. Increase Force

Virginia—The Lincoln mine, a property of the Inter-State Iron Co., is being reopened and placed on an operating basis as rapidly as circumstances will permit. The mine was flooded about a year ago. This is the second property to reopen in this vicinity in the last month.

Nashwauk—The stripping work at the Butler Bros. Co.'s Patrick and North Harrison mines, has been increased by the addition of a night shift. This work has employed an additional 200 men. Practically all the old employees of the company are back at work.

Cuyuna Range

Hillcrest Mine Sinking New Drainage Shaft—Croft Mine Resumes

Ironton—At the Hillcrest mine (Coates & Tweed) work has been started on the sinking of a new drainage shaft for the open pit. The shaft, which will be 8 x 6 ft. inside, is at the foot of the approach, and will be carried to a depth of 160 ft.

The Croft mine (John A. Savage & Co.) resumed underground mining on Jan. 1 after a ten months' shut down. Production will be on a moderate scale for the present, with only a small crew, and much of the work will be confined to development tributary to the new 333 level. The operators state that they have resumed earlier than anticipated, in an effort to assist in relieving the present unemployment situation.

Riverton—A one-mile railroad spur has been completed to connect the new drying plant of the Sagamore mine with the main line, and trestles are being constructed for a lean-ore dump and a new stripping dump in the area northwest of the open pit.

ALABAMA

Iron-Ore Output in 1921 About Half That of Preceding Year—Great Southern Steel Co. May Build New Plant

BY GEORGE HUNTINGTON CLARK

Birmingham—The close of 1921 found thirteen furnaces in blast in Alabama; seven on merchant iron, four on basic, and two on charcoal iron; eight of the thirteen having been blown in between July and the year's end. The recovery over the low point was 75 per cent. The July output was the lowest noted for many years. The output for December, 114,296 tons, was the third largest month's production, being exceeded only by February, with 121,122 tons, and January, with 141,426 tons, the total output for 1921 being 1,195,576 tons. Alabama's pig-iron production in 1912 was 1,862,000; 1913, 2,025,000; 1914, 1,826,000; 1915, 2,049,000; 1916, 2,702,000; 1917, 2,953,000; 1918, 2,587,000; 1919, 2,130,000; and 1920, 2,392,000.

The iron makers enter the 1922 iron market on a base of $16.50, f.o.b. Birmingham district furnaces, a drop of $21.50, or 57 per cent, from the ruling price per ton Jan. 1, 1921.

The decrease in production of iron ore necessarily kept pace with iron making, being in 1921 2,875,000 tons, valued at $6,095,000, as against 5,833,317 tons shipped in 1920 and valued at $15,993,987; representing a decrease in the average value of the ore mined from $2.88 to $2.15 per ton. Of this 1921 production, 78 per cent was red hematite, 21 per cent brown, and 1 per cent magnetic iron ore.

Coal production declined to a low point, reaching its minimum output at 131,354, as against a normal weekly average of 305,000 tons.

It is said that the Great Southern Steel Co. recently announced as the new owners of about 100,000 acres of mineral lands mainly situated in Etowah County, is preparing to build a $500,000 steel-product plant somewhere in Alabama as the initial step toward development of these lands.

SOUTH DAKOTA

Cutting Workings Unwatered

Deadwood—The unwatering of the Cutting workings has been completed and the driving of laterals on the 350 level started. A new pump has been installed and the 500 level is being put in condition for active development.

Galena—Work at the New Silver Queen property is being continued. Shipments of lead-silver ore were made late in the last year. A compressor plant was installed during the year, and production will be increased.

UTAH

Park City Wage Reductions Deferred

Park City—The Silver King Coalition has announced that it will continue the old wage scale, thereby compelling the other operators to defer making the proposed cut. Bingham and Tintic districts have cut wages 50 cents.

THE MARKET REPORT

Daily Prices of Metals

Jan.	Copper, N. Y., net refinery*	Tin		Lead		Zinc
	Electrolytic	99 Per Cent	Straits	N. Y.	St. L.	St. L.
19	13.50	31.75	32.375	4.70	4.40	4.70
20	13.50	31.50	32.125	4.70	4.40	4.65@4.70
21	13.50	31.50	32.00	4.70	4.40	4.65
23	13.50	30.75	31.375	4.70	4.375@4.40	4.65
24	13.375@13.50	30.75	31.375	4.70	4.375@4.40	4.60@4.625
25	13.375@13.50	30.25	30.875	4.70	4.375	4.60

*These prices correspond to the following quotations for copper delivered: Jan. 19 to 23 inc. 13.75c.; Jan. 24 and 25, 13.625@13.75c.

The above quotations are our appraisal of the average of the major markets based generally on sales as made and reported by producers and agencies, and represent to the best of our judgment the prevailing values of the metals for deliveries constituting the major markets, reduced to the basis of New York, cash, except where St. Louis is the normal basing point, or as otherwise noted. All prices are in cents per pound. Copper is commonly sold "delivered," which means that the seller pays the freight from the refinery to the buyer's destination.

Quotations for copper are for ordinary forms of wire bars, ingot bars and cakes. For ingots an extra of 0.05c. per lb. is charged and there are other extras for other shapes. Cathodes are sold at a discount of 0.125c. per lb.

Quotations for zinc are for ordinary Prime Western brands. Tin is quoted on the basis of spot American tin, 99 per cent grade, and spot Straits tin.

London

Jan.	Copper			Tin		Lead		Zinc	
	Standard		Electrolytic						
	Spot	3 M		Spot	3 M	Spot	3 M	Spot	3 M
19	65¼	66⅛	72	163¾	165½	23⅛	23⅛	26¼	26⅝
20	65	65¾	72	162⅝	164¼	23¼	23⅛	26⅛	26½
21	...	...	...	....	....	...	...	...	...
23	65	65¾	71	158¾	160¼	23	22⅞	26	26⅜
24	64⅞	65⅝	71¼	158½	160	23⅛	23	25⅞	26¼
25	65	65¾	71¼	156	157¾	23⅛	23	25½	25⅞

The above table gives the closing quotations on the London Metal Exchange. All prices in pounds sterling per ton of 2,240 lb.

Silver and Sterling Exchange

Jan.	Sterling Exchange "Checks"	Silver			Jan.	Sterling Exchange "Checks"	Silver		
		New York Domestic Origin	New York Foreign Origin	London			New York Domestic Origin	New York Foreign Origin	London
19	421⅞	99⅝	65⅜	34⅞	23	420	99⅝	64⅞	34¾
20	420⅜	99⅝	65	34⅞	24	421½	99⅝	65⅛	35
21	420¼	99⅝	64¾	34¾	25	422	99⅝	65⅛	35

New York quotations are as reported by Handy & Harman and are in cents per troy ounce of bar silver, 999 fine. London quotations are in pence per troy ounce of sterling silver, 925 fine. Sterling quotations represent the demand market in the forenoon. Cables command one-half cent premium.

Metal Markets

New York, Jan. 25, 1922

The local metal markets remain in a state of stagnation, and no improvement can be perceived in the immediate future. The improvement in general business conditions is coming very slowly, and it is likely to be two or three years before prosperity becomes at all general. European affairs remain in a pitiful condition. It is not probable that the metals will experience marked price recessions in the next few months, but it would seem that the gradual improvement which took place during the closing months of 1921 is at an end for the time being, although some improvement in demand is likely, for present sales do not equal consumption.

Copper

Most of the large producers continue to quote prices above the market, up to 14c. delivered, but they are doing practically no business. Those willing to sell at 13.75c. have had no little trouble in getting orders, even for delivery as late as the second quarter, and in some transactions they have been obliged to shade that price. Odd lots of spot copper could have been obtained all week at an equivalent of 13.375c. refinery. The copper market is definitely weaker, and the metal can be obtained at the prices which we quote, for delivery as far ahead as the third quarter. In the closing months of 1921 many consumers bought beyond their immediate requirements on the rising market, and so do not find it necessary to buy more at present. The announced reopening of some of the copper mines, and the expected early resumption of others, have also caused consumers to wait, in the hope that depressed prices will result.

Export business has also been quiet. The Copper Export Association is still keeping around the 14@14.125c. level for European ports, but others are cutting these prices considerably, without attracting much business however.

Lead

The American Smelting & Refining Co.'s official contract price remains at 4.70c. Practically all producers have had an unusually quiet week, though occasional sales have been made. Business in St. Louis was so quiet that over the week-end the price again broke to 4.375c., after going to 4.40c. last Thursday, and by today that price could have been done in at least three directions. Corroding grades continue scarce, however, and several orders were placed during the week at the equivalent of 4.55c. St. Louis.

The London price has declined recently, owing to increased shipments from Australia and probably to the danger from imports of United States lead. A good business can still be done in Mexican lead abroad, but should the London price decline £2 further, Mexican lead might again be sold in this country, provided the duty on it had not been raised by that time.

Zinc

The market continued its decline, but sales have been smaller than for several weeks. Small transactions are setting the market. As is usually the rule in a declining market, consumers are holding off. Galvanizing business has fallen off in the Pittsburgh district, which also accounts for the drop in prices. A few weeks ago there was a prospect of shipping zinc abroad, but that probability has vanished with the decrease in the London zinc market. Although earlier in the week metal was sold for 4.70c., the price today has dropped to 4.60c., and offerings have been made below that level. Some inquiries have been made for forward zinc. High-grade metal continues to be sold for 6c., with freight allowed, with business more active than in the common grades.

New York quotations are 35 points above the St. Louis level, this corresponding to the freight rate.

Tin

The tin market has been further depressed owing to selling pressure in the Far East, and sales are small. Spot metal continues at an appreciable premium owing to the disinclination of manufacturing interests to buy forward supplies.

Tin for future (April) delivery was quoted as follows: Jan. 19th, 31.875@32c.; 20th, 31.25@31.50c.; 21st, 31c.;

23d, 30.75@31c.; 24th, 30.75@31c.; 25th, 30.25@30.50c.

Arrivals of tin, in long tons: Jan. 20th, London, 150; Straits, 375; 23d, Straits, 10; 24th, Australia, 110.

Gold

Gold in London: Jan. 19th, 98s.; 20th, 97s. 6d.; 23d, 97s. 9d.; 24th, 97s. 7d.; 25th, 97s. 6d.

General stock of money in the United States, Jan. 1, 1922: Gold coin and bullion, $3,656,988,551; standard silver dollars, $357,581,851; subsidiary silver, $272,552,485; United States notes, $346,681,016; Federal Reserve notes, $2,781,791,260; Federal Reserve Bank notes, $116,670,400; National Bank notes, $750,167,924; total, $8,282,433,487. Circulation per capita, $53.03. Stocks of gold have increased $112,000,000 in the last month; of silver dollars, $3,000,000; and of notes, $82,000,000.

Foreign Exchange

The foreign exchange market for the week was colorless, with narrow price changes. On Tuesday, Jan. 24th, francs were 8.1325c.; lire, 4.3725c.; and marks, 0.4725c. New York funds in Montreal declined again to 5⅛ per cent premium.

Silver

China has continued to sell in the London market, and any purchases made in New York or San Francisco for China account have been at a price below the London parity. This year the Chinese New Year holidays extend from Jan. 28 to Feb. 1, and China's lack of interest in silver at this time is therefore normal, but as the silver market is fundamentally based on China demand, the present dullness is likely to continue for a time at least.

Mexican Dollars—Jan. 19th, 49¾; 20th, 49⅝; 21st, 49⅝; 23d, 49⅝; 24th, 49¾; 25th, 49¾.

Other Metals

Quotations cover wholesale lots unless otherwise specified.

Aluminum—20c. per lb. for 99 per cent grade; 19c. for 98@99 per cent; 18c. for 94@98 per cent. Outside market nominal at 17@18c. for 98@99 per cent virgin grades.

Antimony—Chinese and Japanese brands, 4.45c.; W. C. C. brand, 5.25@5.75c. per lb. Cookson's "C" grade, spot, 9c. per lb. Chinese needle antimony, lump, nominal at 4c. per lb. Standard powdered needle antimony (200 mesh), nominal at 5.25c. per lb.

White antimony oxide, Chinese, guaranteed 99 per cent Sb_2O_3, wholesale lots, 6¼@7c.

Arsenic—7½c. per lb.

Bismuth—The London price increased on Jan. 17 from 7s. 6d. to 9s., which has occasioned an advance in the New York market to $1.85@$1.95 per lb.

Cadmium—$1@$1.10 per lb. in 1,000-lb. lots. Smaller quantities, $1.10@$1.25 per lb.

Nickel—Standard market, ingot and shot, 41c.; electrolytic, 44c. Small tonnages of spot metal have been offered as low as 32c. Practically no market.

Platinum—$105 per oz.

Palladium—$60@$65 per oz.

Iridium—$170@$200 per oz.

Quicksilver—$48@$50 per 75-lb. flask. San Francisco wires $46.70.

The prices of the following metals remain unchanged from the figures published in these columns on Jan. 7: Cobalt, Molybdenum, Monel Metal, Osmium, Rhodium, Selenium, Thallium and Tungsten.

Metallic Ores

The market is generally exceedingly quiet, and prices on the following ores remain unchanged from the figures published in the Market Report in the Jan. 7 issue: Chrome, Iron, Magnetite, Manganese, Molybdenum, Tantalum, Titanium, Tungsten, Uranium, Vanadium, Zircon, and Zirkite ores.

Zinc and Lead Ore Markets

Joplin, Mo., Jan. 22—Zinc blende, per ton, high, $30; Basis 60 per cent zinc, premium, $27; Prime Western, $26; fines and slimes, $24@$23; average settling price, all grades of blende, $28.81.

Lead, high, $64.45; basis 80 per cent lead, $60; average settling price, all grades of blende, $61 per ton.

Shipments for the week: Blende, 6,775; lead, 1,746 tons. Value, all ores the week, $303,500.

Last week sellers would let but 5,600 tons go on the market at $27 basis, but this week over 10,000 tons was released on $26 basis. Production is generally estimated at 7,000 tons per week. For the three weeks of the year purchases have exceeded production. This, in addition to lowering the reserve stock about 30,000 tons at the close of last year, puts the ore situation in an enviable position with regard to the metal market.

Platteville, Wis., Jan. 21 — Blende, basis 60 per cent zinc, $30. Lead ore, basis 80 per cent lead, $60 per ton. Shipments for the week: Blende, 455; lead, 50 tons. Shipments for the year: Blende, 1,201; lead, 50 tons. Shipped during the week to separating plants, 775 tons blende.

Non-Metallic Minerals

Generally dull markets exist for the non-metallic minerals, and there is no quotable change in the following from the prices published in our Jan. 7 issue: Asbestos, Barytes, Bauxite, Borax, Chalk, China Clay, Emery, Feldspar, Fluorspar, Fuller's Earth, Graphite, Gypsum, Kaolin, Limestone, Magnesite, Mica, Monazite, Phosphate Rock, Pumice Stone, Pyrites, Silica, Sulphur and Talc.

Mineral Products

Sodium Sulphate — For 95 per cent material, $12.50 per ton, f.o.b. in bulk, Western mines, spot and six months' contract; $18@$21 per ton, New York.

Prices of Copper Sulphate, Potassium Sulphate and Sodium Nitrate are unchanged from the quotations published Jan. 7.

Ferro-Alloys

Ferrochrome—Carload lots, spot and contract, 60 to 70 per cent chromium, 6 to 8 per cent carbon, 11½c. per lb. of chromium contained; 4 to 6 per cent carbon, 12c., f.o.b. works.

No quotable changes have taken place in the following ferro-alloys from the prices quoted in the Jan. 7 issue: Ferrotitanium, Ferrocerium, Ferromanganese, Ferromolybdenum, Ferrosilicon, Ferrotungsten, Ferro-Uranium and Ferrovanadium.

Metal Products

Nickel Silver—27.75c. per lb. for 18 per cent nickel, grade "A" sheets.

Zinc Sheets—$8 per 100 lb., less 8 per cent on carload lots, f.o.b. works.

Prices of Copper Sheets, Lead Sheets and Yellow Metal, are unchanged from the quotations published on Jan. 7.

Refractories

Chrome Brick—$41@$44 per net ton.

Silica Brick—9-in., per 1,000, $30@$40 in carload lots, f.o.b. shipping points.

Prices on the following are unchanged from the figures published in the Jan. 7 issue: Bauxite Brick, Chrome Cement, Firebrick and Magnesite Brick.

The Iron Trade

Pittsburgh, Jan. 24, 1922.

Demand for steel products has not increased materially from the rate shown in the latter part of December. As the mills had little forward business, all the buying for a long time past having been for relatively prompt shipment, operating rates reflect the light rate of buying. Production of steel ingots thus far this year has probably been at an average rate of about 18,000,000 gross tons a year, this comparing with an average of 20,000,000 tons in December and 23,000,000 tons in October and November. The higher rate was expected to be regained early in the new year, but scarcely any progress toward that mark has been made.

In most of the finished-steel lines competition between the mills has become much keener in the last week or two. Regular prices, for small lots, are not materially changed, but concessions are now given on much smaller orders than formerly, so that the average selling price is lower. Sheets, however, are absolutely firm, there being no concessions. In tin plate, concessions for large lots are no more common than before the war. Improvement in steel demand is to be expected as spring approaches, but nothing like a fair demand for steel, in proportion to productive capacity, before next fall.

Pig Iron—The market continues inactive, with prices quotable as formerly: Bessemer, $19.50; basic, $18.25; foundry, $19.50, f.o.b. Valley furnaces, freight to Pittsburgh being $1.96.

Coke

Connellsville — Furnace, $2.75@$3; foundry, $3.75@$4.50.

Five Dividend-Paying Gold Mines

BY EDWARD H. ROBIE

Metallurgical Editor *Engineering and Mining Journal*

INVESTORS in the securities of gold-mining companies have one less variable to consider than those who put their money in other mining industries. The price of the product is fixed; at least it is so in the United States and approximately so in Canada, the only two countries here to be considered. Profits will depend upon the amount and grade of ore mined and treated, and the cost of doing the work. The gold produced will, as long as our present financial system endures, be worth $20.67 per oz. in this country, and slightly more in Canada, depending upon the depreciation of the Canadian paper dollar (at present about 5 per cent, but likely gradually to revert to par). Therefore increasing prosperity of gold-mining companies as a class is sure to result with a reduction in the cost of labor and supplies. That such a reduction was sure to come in the period following the war has been universally admitted, so that the securities of gold-mining companies of proved worth have been and are now considered in the front rank of mining investments and speculations.

Five companies will be considered here: Hollinger, McIntyre, Dome, Homestake, and United Eastern. These have been selected because they are the only strictly gold-mining companies of any size which paid dividends during 1920 and 1921 and continue on a dividend basis at the present time. The first three are Canadian companies operating in the Porcupine district of Ontario. Homestake is in South Dakota, and the United Eastern in Arizona. Data as to the operation and character of each of these companies will be mentioned briefly. More information can be obtained from the annual reports of each company, for all except the Homestake issue exceedingly informative and valuable statements.

Hollinger Consolidated Gold Mines, Ltd.—The officers and directors are all residents of Canada, and the principal market for the shares is on the Standard Stock and Mining Exchange of Toronto. The authorized capital is $25,000,000 in 5,000,000 shares of $5 each, 4,920,000 of which are outstanding. The first dividend was paid in November, 1912. The dividend record follows:

1912	$270,000	1917	$738,000
1913	1,170,000	1918	1,230,000
1914	1,170,000	1919	1,722,000
1915	1,560,000	1920	2,214,000
1916	2,160,000	1921	3,198,000

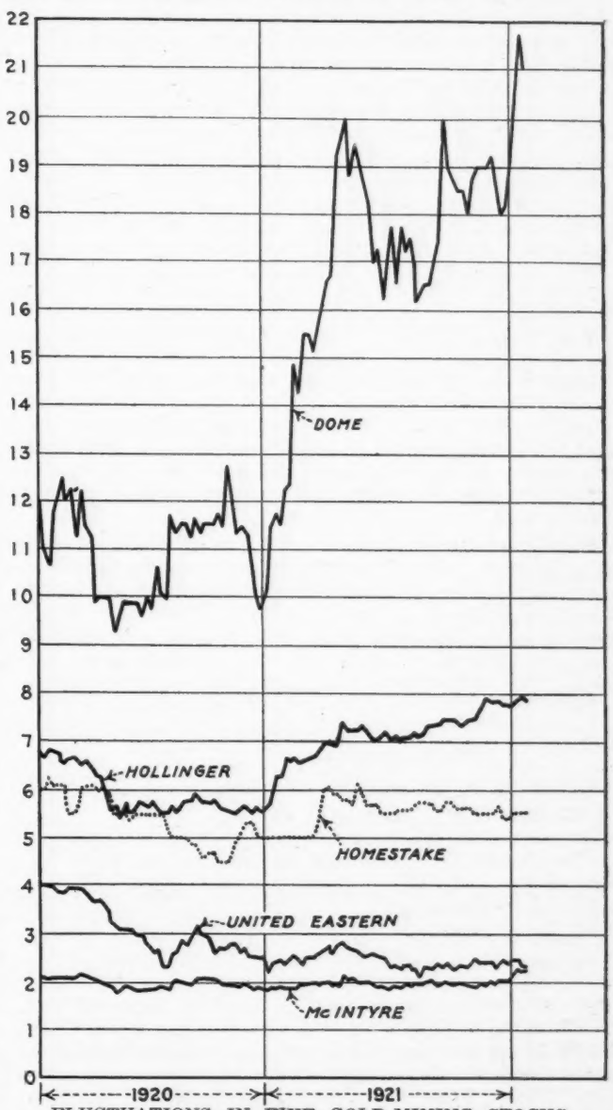
Total to date, $16,558,000

The tonnage treated in 1920 was 650,205, averaging $9.93 per ton, of which about 96.2 per cent was recovered. The operating cost, including general, mining, and milling charges, was $4.83 per ton. The operating profit was $4,018,282, of which taxes and depreciation (but with no allowance for mineral exhaustion) took $1,343,007, leaving a net profit of $2,675,275 available for dividends. The net profit per ton treated was $4.10. Total developed ore reserves on Dec. 31, 1920, were 3,294,000 tons at $11 per ton, or $35,596,000. At the present rate of production this is but little more than two years' supply. However, there is little doubt that vast quantities of ore have not yet been developed. The mine seems of undiminished richness at depth.

In the last year or two Hollinger has been hampered by lack of labor and power. Plenty of men are now available, as well as power for the present mill. If arrangements can be made for more, the mill capacity may be extended to a maximum of 7,000 tons per day. It has already been raised to 4,000. Some criticism has been voiced that, in the effort to mine a large tonnage, ore running under $5 per ton is being passed by which will not again be available, and that this is not conducive to conservation of the mine's resources.

There is little doubt that Hollinger is destined within the next year or two to be the world's leading gold mine in point of current production. Its past cannot of course compare with that of Homestake and some others. Its future prospects appear brilliant. It is, without doubt, the best property in an excellent district.

The fluctuations of the stock appear reasonable and do not indicate manipulation. A regular dividend of 5c. is paid every four weeks, so that, at present prices of close to $8 per share, the stock yields about 8.2 per cent.



FLUCTUATIONS IN FIVE GOLD-MINING STOCKS
Based on Weekly Closing Quotations, Jan. 31, 1920, to Jan. 21, 1922
The price of Homestake is divided by ten.

McIntyre Porcupine Mines, Ltd.—Like the Hollinger, the McIntyre is a Canadian company, only one of the five directors living in the United States. The principal market for the shares has always been on the Standard Exchange in Toronto, but they have recently been listed on the New York Stock Exchange. The authorized capital is $4,000,000 in shares of $1 each, $3,640,283 of which is issued. Dividends date from February, 1917, and are as follows:

1917	$541,542	1920	$546,042
1918	543,042	1921	546,042
1919	364,028		
		Total	$2,540,696

The tonnage treated in the fiscal year ended June 30, 1921, was 171,916, averaging $11.67 per ton, of which about 95 per cent was recovered, the bullion containing 91,330 oz. of gold and 19,806 oz. of silver. The operating cost (excluding development, as was done in the Hollinger summary) was $5.16 per ton. Including development, the cost was $6.33. The operating profit, after providing for development, was $815,563. Of this amount, $272,984 went for taxes and plant depreciation, but $272,951 was received in interest and exchange, largely on investments in coal companies, so the net profit for the year, available for dividends, was $815,530. The net profit per ton treated was $4.75. Total estimated ore reserves are 624,422 tons at $10.25 per ton, or $6,392,000. This is a little over three years' supply for the present mill, which is now handling about 550 tons per day.

Some difficulty has resulted from the presence of carbonaceous ore in certain parts of the mine, but this has been solved in the laboratory and a separate 250-ton unit will be completed in the spring to handle this ore. This will bring the total mill tonnage to about 800 tons per day. Power shortage has hindered operations as with Hollinger, but troubles from this source are unlikely in the future. The extremely dry spring of 1921 was held accountable.

The McIntyre properties adjoin those of the Hollinger, but the ore found is at much deeper levels, and is therefore more problematical. Development, however, is reported extremely favorable at depth, and a long life is expected. These companies are alike in many respects, and are excellent representatives of sound mining enterprises as contrasted with wildcats. Shares in the McIntyre have held closely to the $2 level for the last two years, but have recently advanced slightly on the news of increased mill capacity soon to come into being, and owing to the fact that the shares were to be quoted on the New York Stock Exchange. McIntyre has been paying 5c. every four months recently, so that at present market prices the yield is about 6.7 per cent.

The Dome Mines Co., Ltd.—Dome is an American company formerly connected with the International Nickel interests and under the control of the late J. R. De Lamar. Since the death of Captain De Lamar, J. S. Bache, a New York financier, has been president. Shares have for some years been quoted on the New York Stock Exchange, where most of the transactions are made. The authorized capital is $5,000,000 in 500,000 shares of $10 each, 470,611 of which are issued, and 6,056 more are allotted. The dividend record follows:

1915	$400,000	1919	None
1916	800,000	1920	$419,167
1917	300,000	1921	476,667
1918	none		
		Total	$2,395,834

The tonnage treated in the fiscal year ended March 31, 1921, was 273,700, averaging $7.51 per ton, of which 94.7 per cent, or $7.11, was recovered. The operating cost was $3.56 per ton, not including development. Including development, it was $4.55. The operating profit was $706,894, of which depreciation of plant, and taxes, took $283,251. An allowance of $368,519 was also made for mineral depletion, a factor not provided for by the Hollinger and McIntyre companies. Non-operating revenue amounted to $247,356. The net profit available for dividends was therefore $302,480, or $1.10 per ton treated, although if no allowance had been made for mineral depletion, the profit would have been $2.46 per ton. Ore reserves are not estimated, for the reason that the deposits are extremely erratic, being in the form of large irregular masses entirely without walls and not at all uniform in the distribution of gold. Recent developments at depth are said to indicate somewhat richer ore than has so far been found. In December, 1921, recovery from ore mined was said to be about $8 per ton, which, with operating costs of $4.30, showed a profit of $3.70 per ton.

The costs at the Dome in the spring of 1921 were greatly increased because the power had to be generated from high-priced coal.

About 1,000 tons per day is now being treated, and no arrangements have yet been announced for increasing this figure. It will be noticed that dividends were allowed to lapse during 1918 and 1919; at that time the mill was closed down owing to labor scarcity and high costs.

The Dome mine lies in a different part of the Porcupine district from the first two mines mentioned, and does not have the well-developed vein system of the others. This feature makes the mine more uncertain, although there is apparently yet no sign of failure of ore supply in the large area on which operations are conducted.

The shares of the company have always exhibited wide fluctuations and have evidently received a large amount of attention from speculative interests. This fact, combined with the more uncertain conditions underground, does not make the stock so attractive an investment as Hollinger or McIntyre, though the mine has great possibilities.

Quarterly dividends of 25c. are paid, and a capital distribution of $1 has recently been made in addition to the regular dividends. Including this, the yield, based on the present selling price of $22, is about 9.1 per cent. It is understood that the capital return of $1 is to be made an annual event.

Homestake Mining Co.—Most of the officers and directors of this company are Western men. The stock is quoted on the New York Stock Exchange, but is rarely traded in. The authorized capital of $25,116,000 consists of 251,160 shares of $100 par value each. The dividend record is a long and honorable one, dating from January, 1879, monthly payments being made. They were suspended from May, 1907, to January, 1908, owing to a bad fire, and from December, 1909, to March, 1910, owing to labor troubles. To date they total $41,417,704, a remarkable showing.

The tonnage treated in 1920 was 1,274,944, from which was realized an average of $3.46 a ton. Costs for that year are virtually meaningless, for the reason that owing to a flooded mine and labor scarcity operations were suspended or curtailed for a considerable time. The fire which began in September, 1919, and which necessitated flooding the mine, cost the company $1,000,000. Recently the mill has been treating about 4,000 tons per day, but this amount will be increased soon as a result of added equipment. Costs are understood to be about $2.60 per ton. No estimates of ore reserves are made by the management, but the mine is considered still to be far from exhausted.

Possibly in no mining company is more of an effort made to divorce operations at the property from the stock market. No information is given out which would tend to influence the price of shares, and intending investors must depend on the long dividend record of the company and its excellent management. W. H. Weed, in the 1920 edition of "The Mines Handbook," says: "The Homestake is the greatest gold mine in the world, judging by its past performance, present condition, and possibilities. Management says little but produces the gold and dividends."

At present, dividends of 25c. monthly are paid, which yield about 5.5 per cent at present prices (about $55 per share). The somewhat irregular stock price curve is accounted for by the infrequency of sales.

United Eastern Mining Co.—This company operates in the Oatman district of Arizona. It is capitalized at $1,500,000, of which there are 1,360,000 shares of $1 each outstanding. It is marketed chiefly on the New York Curb Exchange. The dividend record follows:

1917	$408,900	1920	$981,360
1918	845,060	1921	817,800
1919	899,580		
		Total	$3,952,700

Costs at the United Eastern are not of great interest to the investor, because the Tom Reed Extension Mine, which has so far supplied the ore, is expected to be exhausted in about one more year. The company will gradually develop an adjoining mine, the Big Jim, but it is yet too early to say how long a life this property will have. Shares are evidently considered a speculation, for the price has declined to $2.25, thus yielding between 26 and 27 per cent on the investment at the current rate of dividend of 15c. per quarter. The United Eastern has been a good property and may be a profitable enterprise for a few years yet, but is not likely to develop into anything to be compared with the other four mines discussed.

COMPANY REPORTS

The Cape Copper Co.

A report of operations of the Cape Copper Co. for the year ending April 30, 1921, in South Africa, and August 31, 1921, in London and India states that a deficit for the year of £184,534 17s. 10d. was incurred.

Profit and loss account follows:

Dr.	£	s.	d.	£	s.	d.
Costs at Rakha Hills Mines	85,977	12	6			
Costs in South Africa, including depreciation	13,248	13	5			
Costs in Newfoundland	179	1	7			
Transport and shipping, including depreciation	6,199	8	9			
				105,604	16	3
Losses on realizations and revaluations of stocks of copper				73,152	12	4
Management in London				6,835	13	2
Bank Commission and Exchange				383	12	2
Interest and Discount				22,243	16	9
Interest on Debentures—paid and accrued				6,213	5	11
Miscellaneous				1,079	13	10
Depreciation (India)				8,632	15	3
				£224,146	5	8
Cr.				£	s.	d.
Copper ores and metal				38,416	19	5
Rent and stores account				1,194	8	5
Balance carried down				184,534	17	10
				£224,146	5	8
Dr.						
Balance brought down				184,534	17	10
Balance from Profit and Loss Account 1919-20				189,670	19	1
Taxes outside the United Kingdom				370	8	2
				£374,576	5	1
Cr.						
Income Tax Refund				600	15	2
Balance				373,975	9	11
				£374,576	5	1

Deficit shown in accounts is attributable to serious losses on realizations and revaluations of copper stocks, to heavy charges for interest, to maintenance expenses connected with the company's establishments in South Africa and Briton Ferry, and to the unfavorable conditions which have prevailed in India, resulting in a loss in the working of the Rakha Hills Mines.

The additional plant for which provision was made in the debenture issue in November, 1920, has been erected at Rakha, but the company's operations there have been severely affected by numerous difficulties, chiefly those connected with transport, supplies of coal, coke and fluxes for the smelter, labor trouble and breakdowns of plant. The company being at present entirely dependent on the Rakha Mines for revenue, the effect of the disturbed state of India on its affairs is very serious.

Mining operations in South Africa have remained suspended during the year. The O'okiep Mine was kept unwatered until March last, when an exceptionally severe thunderstorm occurred, resulting in the flooding of the lower workings of the mine.

The estimated reserves at the Nababeep Mine remain at the same total as at the close of the previous year, viz., 90,000 tons of 5 per cent copper, wet assay.

In India from the No. 1 shaft of the Rakha Hills Mines 19,941 tons of ore assaying 4.07 per cent copper were sent to the treatment plant.

The ore reserves at the Nos. 1 and 4 shaft workings, including ore broken at surface, but without any deduction for ore in shaft pillars, are estimated at 329,151 short tons of an average assay value of 3.60 per cent copper, compared with 354,688 short tons of 3.66 per cent ore at the close of the previous year, both estimates being over an average lode width of 42 inches.

Of the reserves 297,575 tons of 3.74 per cent is developed ore, and 31,576 tons of 2.34 per cent is probable ore.

Capitalization: 400,000 shares £2 each, of which 360,000 are issued; 75,000, 6 per cent cumulative preference shares of £2 each, of which 45,000 have been issued; 1,200 first mortgage 8 per cent debentures of £100 each.

Superior & Boston Copper Co.

A report of operations of the Superior & Boston Copper Co. for the year ending Sept. 30, 1921, states that 5,835 ft. of development work, and, in addition, 1,036 ft. of diamond drilling was done. This compares with 8,397 ft. of development work the previous year. The decrease is due to the curtailment in operations, which, instituted in November, has become more and more drastic from time to time, as conditions dictated, until at the present time operations underground in the McGaw shaft have been suspended, except for pumping and a nominal amount of repair work, necessary to keep the workings open.

The copper smelters of the Southwest closed in April, stopping for the time the production of copper ore. Until then, there had been shipped since the beginning of the fiscal year, 11,107 (dry) tons of ore, assaying 4.37 per cent copper, 5.88 oz. silver, containing 970,653 lb. of copper and 65,352 oz. of silver, for which was received $95,022.74, after deducting freight and smelting charges.

RECEIPTS AND DISBURSEMENTS FOR YEAR ENDED SEPT. 30, 1921

Receipts		
Ore sales	$103,501.06	
Ore in transit	6,231.68	
Royalties	123.61	
		$109,856.35
Profit and Loss		
Interest on deposits	$3,659.32	
Interest on calls of capital stock	1,268.77	
Interest on employees insurance fund	230.69	
		5,158.78
		$115,015.13
Account calls No. 9 collected		15,557.00
Account calls No. 10 collected		113,449.50
		$244,021.63
Disbursements		
General development		$244,830.74
General expense		21,960.50
General equipment		2,563.40
Mining patents		1,883.50
Mining claims		6,250.00
Call No. 10 on account treasury stock (included in receipts above)		2,598.50
		$280,086.64

Capital stock listed is 297,827 shares at $9 each.

Portland Gold Mining Co.

A report of operations of the Portland Gold Mining Co. for the year 1920 shows a loss of $442,094.72, exclusive of a dividend of $195,000 paid during the year, as the following profit-and-loss account shows:

Gross value of ore mined and shipped	$887,533.04
Values recovered by mills (*a*)	663,107.62
	$1,550,640.66
Net cost of mining and milling	1,474,100.35
Net profit from operation of mines and mills	$76,540.31

(*a*) Includes 14,794 tons Portland shipping ore and 2,496 tons custom ore.

DETAILED STATEMENT OF PROFIT AND LOSS FOR THE YEAR 1920

Net profit from operation			$76,540.31
Interest on bank balances			1,354.09
Interest on corporation bonds owned			300.00
Interest on bills receivable			2,380.00
Interest on open accounts			1,493.38
Interest on Liberty Bonds			942.04
Discount			998.46
Registration fees			25.10
Interest on notes payable		$187.50	
Discount on Liberty Bonds sold		1,629.33	
Depreciation:			
Permanent equipment	$27,648.64		
Independence mill	92,390.73		
Furniture and fixtures	333.78		
		120,373.15	
Depletion		199,059.10	
Loss on sale of Colorado Springs mill		119,362.86	
Loss on sale of Victor mill		85,516.16	
Net loss to surplus			442,094.72
		$526,128.10	$526,128.10
SURPLUS			
Balance, Jan. 1, 1920			$819,531.97
Net loss for 1920		$442,094.72	
Dividends		195,000.00	637,094.72
Balance, Jan. 1, 1921			$182,437.25

MINING STOCKS

Weeks Ended January 14 and 21, 1922

Stock	Jan. 14 High	Jan. 14 Low	Jan. 14 Last	Jan. 21 High	Jan. 21 Low	Jan. 21 Last	Last Div.	
COPPER								
Ahmeek	61	61	61	64	60½	63	Sept. '20, Q	$0.50
Alaska-Br. Col.	2½	1⅞	2⅛	2⅜	2⅛	2⅛		
Allouez	23	22	22	30	24	30	Mar. '19	1.00
Anaconda	49⅜	48½	48½	50½	48⅝	50	Nov. '20, Q	1.00
Arcadian Consol.	3⅛	2⅜	2⅜	2⅝	2⅜	2⅜		
Ariz. Com'l	9	8⅜	9	9	8⅝	9	Oct. '18, Q	.50
Big Ledge	*27	*25	*26	*29	*25	*28		
Bingham Mines	13	13	13	14	13½	14	Sept. '19, Q	.25
Calumet & Ariz.	58	55½	57½	59	57½	59	Dec. '21, Q	.50
Cal. & Hecla	270	265	270	280	273	280	June '20, Q	5.00
Canada Copper	*43	*37	*43	*36	*25	*26		
Centennial	10	10	10	9½	9½	9½	Dec. '18, SA	1.00
Cerro de Pasco	35	33	35	35½	24	35	Mar. '21, Q	.50
Chile Copper	16⅛	15½	16⅛	18⅛	16½	18		
Chino	27½	26⅜	27⅜	28¼	27⅛	28½	Sept. '20, Q	.37½
Columbus Rex	*16½	*16½	*16½	†30	†21	*16½		
Con. Ariz.	*3	*3	*3	....	....	*3	Dec. '18, Q	.05
Con. Copper	1⅛	1⅛	1⅛	1⅜	1¼	1 7/16		
Copper Range	41¼	37½	41½	44⅝	42	44⅝	Sept. '20, Q	.50
Crystal Cop.	*63	*57	*61	*62	*52	*56		
Davis-Daly	6⅞	6½	6⅞	7	6¾	6⅞	Mar. '20, Q	.25
East Butte	11½	10½	11⅛	12	11	12	Dec. '19, A	.50
First Nat'l	*75	*69	*75	*80	*65	*65	Feb. '19, SA	.15
Franklin	2⅛	1⅞	1⅞	2	1⅞	1⅞		
Gadsden Cop.	†*50	†*40	*50	*45	*35	*40		
Granby Consol.	....	....	26½	30⅜	27½	30½	May '19, Q	1.25
Greene-Cananea	26⅛	26	26	....	....	26	Nov. '20, Q	.50
Hancock	2½	2	2	2½	2½	2½		
Howe Sound	2½	2⅜	2½	2⅝	2½	2⅝	Jan. '21, Q	.05
Inspiration Con.	40	38	40	40⅜	39½	40¼	Oct. '20, Q	1.00
Iron Cap	7½	7½	7½	7	6	7	Sept. '20, K	.25
Isle Royale	24	22½	24	25	24½	25	Sept. '19, SA	.50
Kennecott	26⅛	25⅜	26⅛	30½	26½	30	Dec. '20, Q	.50
Keweenaw	1⅛	1⅛	1⅛	1¼	1¼	1¼		
Lake Copper	2⅜	2⅜	2½	2⅜	2½	2½		
La Salle	1¼	1¼	1¼	2	1¼	2		
Magma Copper	30	27¾	28½	30	28	30	Jan. '19, Q	.50
Majestic	†*6	†*4	*4	†*6	†*4	*4		
Mason Valley	1⅜	1⅛	1⅜	1⅜	1⅛	1⅛		
Mass Consol.	2⅜	2⅜	2⅜	2⅜	2⅜	2⅜	Nov. '17, Q	1.00
Miami Cop.	27⅛	26⅝	27⅛	27⅞	27	27⅝	Nov. '21, Q	.50
Michigan	2	2	2	2⅛	1⅛	2⅛		
Mohawk	56	53⅜	55	57	55½	57	Nov. '20, Q	1.00
Mother Lode	7½	7	7⅛	9½	7⅞	8⅜		
Nevada Con.	15	14⅛	15	15⅛	14⅜	15⅜	Sept. '20, Q	.25
New Cornelia	18	17⅛	17⅜	18⅝	17⅛	18⅜	Aug. '20, K	.25
North Butte	13½	12⅛	13⅜	14⅛	13	14⅛	Oct. '18, Q	.25
North Lake	*25	*25	*25	†*40	†*20	*25		
Ohio Copper	....	....	*8	*10	*9	*10		
Old Dominion	25½	23½	25	26½	25	26½	Dec. '18, Q	1.00
Osceola	32½	30½	32½	34½	32½	34½	June '20, Q	.50
Phelps Dodge	†175	†160	....	†175	†160	....	Jan. '22, Q	1.00
Quincy	42½	41½	42	45½	43½	45	Mar. '20, Q	1.00
Ray Con.	15	14⅛	14⅜	15¼	14⅛	15	Dec. '20, Q	.25
Ray Hercules	*7	*4	*4	*4	*3	*4		
St. Mary M. L.	45½	41⅛	45½	46	44½	45	Dec. '21, K	1.00
Seneca Copper	....	....	24½	17⅜	17	17⅜		
Shannon	1 1/16	1	1	1⅛	1	1⅛	Nov. '17, Q	.25
Shattuck Ariz.	8¼	8¼	8¼	9	8¼	8¼	Jan. '20, Q	.25
South Lake	†1.00	†*55	*60	*60	*60	*60		
Sup. & Boston	1¼	*92	1	1 1/16	1	1		
Tenn. C. & C.	10⅛	9¾	10	10⅛	9⅞	10⅛	May '18, I	1.00
Tuolumne	*80	*52	*74	*77	*70	*70	May '13	.10
Un. Verde Ex.	29½	27⅜	28⅝	30⅜	28⅜	30⅜	Nov. '21, Q	.25
Utah Consol.	1⅜	1⅛	1⅜	2	1⅝	1⅝	Sept. '18,	.25
Utah Copper	64⅝	61¼	63⅝	65⅛	63	64¼	Dec. '21, Q	.50
Utah M. & T.	1¼	1⅛	1¼	1¼	1¼	1¼	Dec. '17	.30
Victoria	†1⅛	†1⅛	1⅛	2	2	2		
Winona	*40	*40	*40	*40	*35	*40		
Wolverine	10½	10½	10½	11	10½	11		
NICKEL-COPPER								
Int. Nickel	12	11½	12	12⅝	11⅞	12⅝	Mar. '19,	.50
Int. Nickel, pfd.	67	62½	67	69	67½	69	Nov. '21, Q	1.50
LEAD								
Nat. Lead	92	85	92	91½	88⅞	90	Dec. '21, Q	1.50
Nat. Lead, pfd.	110⅛	118	110⅛	111	111	111	Dec. '21, Q	1.75
St. Joseph Lead	13	12⅛	13	13	13	13	Dec. '21, Q	.25
QUICKSILVER								
New Idria	†1½	†*75	1⅛	1	1	1		
ZINC								
Am. Z. L. & S.	13½	13	13½	14⅜	13¼	14¼	May '20,	1.00
Am. Z.L.&S.pf.	38½	37½	37½	39½	36	37	Nov. '20, Q	1.50
Butte C. & Z.	5¾	5⅜	5⅜	6½	5½	6½	June '18,	.50
Butte & Sup.	23¾	20½	23	27½	22⅝	26½	Sept. '20,	1.25
Callahan, Z. L.	6	5½	5¾	6½	5¾	6	Dec. '20, Q	.50
New Jersey Z.	126	125	126	133½	127	131	Nov. '21, Q	2.00
Yellow Pine	*50	*50	*50	....	....	*50	Sept. '20, Q	.03

*Cents per share. †Bid or asked. Q, Quarterly. SA, Semi-annually.
BM, Bi-monthly. K, Irregular. I, Initial. X, includes extra.

Stock	Jan. 14 High	Jan. 14 Low	Jan. 14 Last	Jan. 21 High	Jan. 21 Low	Jan. 21 Last	Last Div.	
GOLD								
Alaska Gold	1/32	1/32	1/32	1/32	1/32	1/32	....	
Alaska Juneau	1/32	1/32	1/32	1/32	1/32	1/32	....	
Carson Hill	12⅛	11⅝	12	13⅞	12⅛	13⅛	....	
Cresson Consol.	2 7/16	2⅜	2 7/16	2 11/16	2 7/16	2 11/16	Jan. '22, Q	$0.10
Dome Ex.	*75	*73	*75	*78	*75	*75	....	
Dome Mines	21¼	20⅛	21⅛	23	21	21	Jan. '22, Q	.25
Flor. Goldfield	*26	*20	*21	*23	*20	*23	....	
Golden Cycle	*70	*69½	*70	*71	*71	*71	June '21, Q	.02
Goldfield Con.	*5	*3	*3			*3	Dec. '19,	.05
Hollinger Con.	8.00	7.88	7.98	8.10	7.90	7.98	Dec. '21, 4 wks.	.05
Homestake	55	55	55			55	Dec. '21, M	.25
Kirkland Lake	*35	*28	*30½	*35	*31	*35	....	
Lake Shore	1.40	1.32	1.35	1.39	1.28	1.30	Nov. '21, K	.02
McIntyre-Por.	2.27	2.18	2.20	2.28	2.22	2.26	Jan. '22, K	.05
Porcupine Cr.	*18	*12	*12	*17	*14	*15½	July '17,	.03
PorcupineV.N.T.	*21	*19⅛	*20	*22	*19	*20	....	
Portland	†*42	†*32	*39½	†*42	†*30	*39½	Oct. '20, Q	.01
Schumacher	*35	*32½	*34½	*36	*34	*35½	....	
Silver Pick	*6	*6	*6	*6	*2	*6	....	
Teck Hughes	*23½	*22	*23	*30	*27	*29½	....	
Tom Reed	*45	*39	*44	*55	*46	*50	Dec. '19,	.02
United Eastern	2⅛	2¼	2¼	2⅛	2¼	2¼	Oct. '21, Q	.15
Vindicator Con.	*23	*21	*23	*23	*23	*23	Jan. '20, Q	.01
White Caps	....	....	*5	*4	*4	*4	....	
Yukon Gold	1⅛	1⅛	1⅛	1 1/16	1 1/16	1⅛	June '18,	.02½
SILVER								
Batopilas Mining	1/32	1/32	1/32	1/32	1/32	1/32	Dec. '07, I	.12½
Beaver Con.	*24	*21	*23	*23	*21	*22	May '20, K	.03
Coniagas	1.50	....	1.50	1.50	1.30	1.50	May '21, Q	.12½
Crown Reserve	*17	*15	*15	*15	*13½	*14	Jan. '17,	.05
Kerr Lake	3⅜	3⅛	3¼	†3½	†3¼	3¼	Jan. '22, Q	.12½
La Rose	*33½	*33	*33½	*34	*33	*30	Apr. '18,	.02
McK. Dar-Sav.	*17	*15	*16	....	....	*16	Oct. '20, Q	.03
Mining Corp.	1.10	1.00	1.05	1.00	....	1.00	Sept. '20, Q	.12½
Nipissing	6⅛	6⅛	6⅛	6⅜	6⅛	6⅜	Jan. '22, Q	.15
Ontario Silver	....	....	4	5⅜	4⅜	5⅛	Jan. '19, Q	.50
Ophir Silver	....	....	*12	....	....	*12	Jan. '12,	.10
Temiskaming	*32	*28	*31½	*35	*29	*34	Jan. '20, K	.04
Trethewey	*7½	*6½	*7	*9	*7	*7½	Jan. '19,	.05
GOLD AND SILVER								
Bost. & Mont.	*87	*71	*74	*75	*62	*63	....	
Cashboy	....	....	*5	*5	*5	*5	....	
Dol. Esperanza	....	....	*90	....	....	*90	....	
El Salvador	*5	*4	*4	*5	*4	*4	....	
Jim Butler	....	....	*6	....	....	*6	Aug. '18, SA	.07
Jumbo Exten.	....	....	*4	*2	*2	*2	June '16,	.05
MacNamara M.	*10	*5	*7	*9	*6	*7	May '10,	.02½
Tonopah-Bel.	1 1/16	1⅛	1 1/16	1 1/16	1 1/16	1 1/16	Jan. '22, Q	.05
Tonopah	*65	*61	*61	*74	*62	*74	....	
Tonopah Ex.	1 1/16	1⅛	1 1/16	1⅛	1 1/16	1⅛	Jan. '22, Q	.05
Tonopah Min.	1 1/16	1 1/16	1⅛	1 1/16	1 1/16	1⅛	Oct. 21, SA	.05
West End Con.	*78	*75	*75	*78	*74	*77	Dec. '19, SA	.05
SILVER-LEAD								
Caledonia	....	....	*7	*6	*6	*6	Jan. '21, M	.01
Cardiff M. & M.	1.05	1.00	1.05	1.00	1.00	1.00	Dec. '20,	.15
Chief Consol.	3⅛	3⅛	3⅛	3 1/16	3	3	Aug. '21, Q	.05
Consol. M. & S.	20⅜	19	20⅛	20⅜	20⅛	20⅛	Oct. '20, Q	.62½
Daly Mining	†3.00	†1.00	....	†3.50	†1.00	....	July '20, Q	.10
Daly-West	2	1⅛	2	2	2	2	Dec. '20, Q	.25
Eagle & B. B.	†3	†2½	2½	2½	2½	2½	Apr. '21, K	.05
Electric Point	*4½	*4	*4	*4½	*4	*4	May '20, SA	.03
Fed. M. & S.	10	10	10	....	....	10	Jan. '09,	1.50
Fed. M. & S. pf.	38	37	37	40½	38	40	Dec. '21, Q	1.00
Florence Silver	*18	*18	*18	*18	*18	*18	Apr. '19,	.01½
Grand Central	†*63	†*36½	*41	*45	*45	*45	Jan. '21, K	.01
Hecla Mining	4⅛	4⅛	4⅛	4 11/16	4⅛	4⅛	Dec. '21, Q	.17
Iron Blossom	*21	*19	*21	*22	*22	*22	Dec. '21, Q	.02½
Judge M. & S.	†3.00	†2.00	2.50	†3.00	†2.00	2.50	Sept. '20, Q	12½
Marsh Mines	*6	*5	*5	*6	*4	*4	June '21, I	.02
Prince Consol.	*14½	*10	*10	*10	*8½	*8½	Nov. '17,	.02½
Rambler-Carib.	*4	*4	*4	*4½	*3½	*4	Feb. '19,	.01
Rex Con.	*7	*6	*6	*7	*6	*7	....	
South Hecla	....	†*12½	....	....	†*12½	....	Sept. '19, K	.15
Stand, S. L.	*11	*11	*11	....	....	*11	Oct. '17,	.05
Stewart Mines	....	....	*2	*4	*2	*4	Dec. '15,	.05
Tam.-Custer	2.20	2.15	2.20	2.15	2.10	2.10	Jan. '21, K	.04
Tintic Stand	2.00	1.95	2.00	2.00	1.95	2.00	Dec. '21, Q	.05
Utah Apex	2⅛	2⅛	2⅛	2⅛	2⅛	2⅛	Nov. '20, K	.25
Wilbert Min.	....	....	2	....	....	2	Nov. '17,	.01
VANADIUM								
Vanadium C.	31⅛	30¼	31	37⅞	31¼	34	Jan. '21, Q	1.00
ASBESTOS								
Asbestos C.	48⅛	48¼	48¼	....	....	48	Jan. '22, Q	1.50
Asbestos Cp., pfd	....	....	76	....	....	76	Jan. '22, Q	1.75
SULPHUR								
Freeport, Texas	13	12⅛	12⅛	13	12¼	12⅛	Nov. '19, Q	1.00
Texas Gulf	42⅛	40	41¼	42⅛	40⅜	41¼	Dec. '21, Q	1.00
MINING, SMELTING AND REFINING								
Am. S. & R.	45½	43⅛	45½	48	45½	47⅛	Mar. '21, Q	1.00
Am. S. & R. pf.	88	86⅛	88	91⅛	89¼	90⅜	Dec. '21, Q	1.75
Am. Sm. S. pf. A	....	....	87½	89	89	89	Jan. '22, Q	1.50
U.S.S.R.&M.	36	34½	36	37½	36	37½	Jan. '21, Q	.50
U.S.S.R.&M., pf.	44	43⅛	44	43⅞	43⅛	43⅞	Jan. '22, Q	.87½